COMMON SENSE ARITHMETIC

PART II.

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COMMON-SENSE

ARITHMETIC

FOR

COMMON SCHOOLS.

SECOND PART.

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ADVERTISEMENT.

The *Second Part* of the *Common-Sense Arithmetic* has been prepared for use as a text-book in the Grammar Grades of the common schools, with a view to such a selection and arrangement of subject matter as will enable the teacher and pupil not only to secure better results in this important branch of school study, but also to save time that may be profitably devoted to other studies quite as useful. It is not claimed to be a 'brief course,' — it provides quite as much, if not more, oral and written work than the ordinary Complete Arithmetic, and treats fully every topic which may reasonably be placed before the average class in the fifth, sixth and seventh or eighth years or grades of school life.

The text is made up from school-room work as it has been done, and is done, with reference to the application of arithmetical facts and processes in practical affairs. On examination, it may be found peculiar in these particulars: that it contains the essentials of a mental and written arithmetic combined; that it insists upon the constant reference of number to real things; that it provides, with the clear statement of whatever of theory is given, more than the usual number of exercises calculated to fix the facts and processes presented; that the character of the exercises compels the teacher and pupil to review constantly previous work.

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SUGGESTIONS TO TEACHERS.

1. The *Second Part* of the *Common-Sense Arithmetic* should not be placed in the hands of pupils, as a text for study, until they have mastered fairly the *First Part* or some text of similar grade and character. *Such a preparation is imperative.*

Such expressions as (S. 5) in the text, refer to these suggestions.

2. All definitions, principles, processes and measures should be clearly illustrated — objectively, when necessary.

3. The articles containing examples and problems, as Art. 43, page 18, may ordinarily be assigned singly as lessons; if they be so taken, at the rate of four or five per week, *and each section be reviewed before proceeding to the next,* the exercises provided will be found sufficient for the work of the fifth, sixth and seventh school years or grades. Avoid advancing too rapidly. *The average pupil and class must have time for growth.*

4. The first half of the recitation period should be devoted to examination of the work assigned for study, and the remainder to dictation work on preceding topics. Dictation work should be wholly within the range of previous work and *double the amount of the regular text-book work.* This, together with intelligent objective illustration, is the key to success in teaching arithmetic. *Pupils should be trained to prove their work.*

5. Each article contains work on the topic under which it is found, and more or less in review of previous work. No distinction between 'oral' and 'written' work is made — none can naturally be made. Ordinarily, about half of the examples and problems may be solved orally.

Do not assign a lesson until you know from examination what it contains. Point out its greater difficulties.

All analyses should be logical, and expressed in well chosen language. Clearness and neatness of statement are of primary importance. There should be no looseness in the use of number, mode and tense. Set forms of statement should be avoided; correct results do not always demand an initial 'if' or 'since.'

All written work should be scrupulously neat in form and arrangement. The importance of this, in its relation to practical affairs, can not be overestimated.

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Have pupils make similars to given problems, and problems to suit given examples and conditions. One such problem, made and analyzed by a pupil, is worth more to him than a dozen set examples and problems from a text-book.

6. With Art. 21, take Art. 201 for additional exercises.

7. Addition is the most important topic in the work in arithmetic,— it is the basis of the other operations, and pupils should have sufficient practice to enable them to add readily and accurately. Close attention is an essential condition.

8. With Multiplication, teach the *squares* of the numbers 1 to 25, and the *cubes* of the numbers 1 to 10.

Show how to multiply by 10, 100, etc., according to Art. 18, III.

9. With Division, teach the numbers 1 to 25 as *square roots*, and the numbers 1 to 10 as *cube roots*.

Show how to divide by 10, 100, etc., according to Art. 18, IV.

The theory of 'long division' is not given in the text, and is not worth teaching; teach *how*, using this formula:

I. Find a number on the left of the dividend that will contain the divisor.
II. Find how many times.
III. Multiply.
IV. Subtract.
V. Annex the remainder to the next dividend figure, etc.

10. In the solution of all problems relating to measurement, pupils should illustrate their work with appropriate sketches. Pupils should measure real areas, solids, lumber, etc., and cut out and build given forms and solids — as the triangle, square, rectangle, circle, cube, etc.

11. The prime numbers, and the prime factors of the composite numbers, from 1 to 100, should be thoroughly memorized.

12. The G. C. D. of numbers has little practical use — the G. C. D. of more than two numbers none whatever. The topic may be omitted. The process of finding the G. C. D. 'by division' may be taught as a curiosity.

13. Pupils should be trained to find the L. C. M. by inspection. They should see clearly that it can not be smaller than the largest number, or twice the largest number, or three times the largest number, etc.,—that it equals the largest number multiplied by all the prime factors in the others not found in that number.

14. Pupils should learn to use cancellation and straight-line analysis readily, and should have thorough drill in their application. Straight-line analysis is a most convenient form for the statement of problems involving two or more processes, and should be used whenever practicable. The simple indication of a solution by this process is often as conclusive as a complete solution.

15. Show the relation of Art. 120, I. and II., Art. 60, III. and IV., and Art. 202, I. and II.

16. Show, and have pupils show, the reductions and simple operations in Fractions with objects. Sheets of paper separated into fractional parts will serve the purpose.

17. In multiplying a mixed number by an integer, as $253\frac{3}{4}$ by 5, do not reduce the mixed number to an improper fraction. Say: "5 times 3 fourths are 15 fourths, or $3\frac{3}{4}$; 5 times 3 are 15, $18\frac{3}{4}$; 5 times 5 are 25, 26, etc."

18. In finding one of the equal parts of a mixed number, as one fourth of $95\frac{2}{3}$, the mixed number should not be reduced to an improper fraction, — divide the wholenumber first. Say: "one fourth of 8 is 2; one fourth of twelve is 3; $3\frac{2}{3}$ equal $\frac{11}{3}$, and one fourth of $\frac{11}{3}$ is $\frac{11}{12}$, etc." 'Complex Fractions' are not treated in the text, — they are not often found except in teachers' examinations. The teacher may show, however, that such forms are simply indicated divisions.

19. In reducing common fractions to decimals, ordinarily not more than four decimal places need be used; in Division of Decimals and U. S. Money it is seldom necessary to carry the quotient beyond the fourth decimal place.

In reducing a complex decimal to a common fraction, follow this form: $.04\frac{2}{7} = \frac{30}{7}$ of $\frac{1}{100} = \frac{3}{70}$.

20. Pupils should have much practice in making out bills.

21. Insist upon straight-line analysis in these problems.

22. Many weights and measures commonly found in text-books, are obsolete; as, 16 drams = 1 ounce, 25 pounds = 1 quarter, etc.

23. The statement of 'carpet' problems, as commonly given, is meaningless. The proper form of statement and solution is as found in Art. 310, page 100. In practice, the questions are: "Which way shall the strips run?" "How long must the strips be?" "How many strips must there be?" etc. Have pupils measure rooms for carpets, requiring allowances for matching, etc.

24. 'Longitude and Time' is properly a topic in geography, and not treated in this text.

25. In the Three Problems in Percentage, solutions by 'analysis' are given, being preferable to formulas for beginners. Straight-line analysis may be used in most cases. Before taking this section, review Arts. 176–190. *All concrete numbers used in analyses should be definitely named.*

26. Have pupils find and illustrate the meaning of the terms used in problems relating to Profit and Loss, Commission, Insurance, etc.

Pupils should understand clearly that profit or loss is always computed on the *cost.* That commission is always computed on the amount of the *sale*, *purchase* or *collection*, that commission on the purchase or sale of stocks and bonds is always computed on their face value.

27. Very few people ever have occasion to compute interest; it is, therefore, unwise to undertake to teach several methods to a class of beginners, and all so-called short methods are worse than useless. Teach only the simple processes, and these thoroughly, — the forms in Arts. 379 and 382 are sufficient. If a pupil should, at some future time, find practical use for other methods, he will doubtless have sufficient intelligence to enable him to master the required method in a few hours.

In finding interest for short time, use the process in Art. 382.

28. In Partial Payments, teach the U. S. Court rule only, — ninety-nine pupils in every hundred will never have use for any other.

29. Problem 5, Art. 407, is the only practical one in Bank Discount. In case a certain sum is wanted, the 'face of the note' is never found by the process usually given in text-books — time is too valuable. One who borrows at a bank, will soon learn how the face of a note is found.

30. This text provides all the arithmetic the average pupil will need to know. A Fifth year class should advance through Fractions; a Sixth year class should review Fractions and advance through Measurements; a Seventh year class should review Fractions, Decimals and Measurements and complete the book; an Eighth year class may review the book thoroughly with profit.

COMMON-SENSE ARITHMETIC.

SECOND PART.

SIMPLE NUMBERS.

I. NOTATION.

1. A Unit is a single thing, one of any kind, or several taken together as one whole; as, *one foot*, *one*, *a dollar*, *a dozen*, *a hundred.*

2. A Number is a unit or a collection of units; it is that which tells 'how many;' as, *two*, 9, 7 *feet*, \$8, $3\frac{1}{2}$.

3. A Concrete Number is one in which the kind of units is named; as, \$3, 5 *yards*, $\frac{3}{4}$ *lb.*

4. An Abstract Number is one in which the kind of units is not named; as, 3, 5, $\frac{3}{4}$.

5. Similar or **Like Numbers** are such as have the same kind of units; as, \$2 and \$7; 3 *pints* and 5 *pints.*

6. An Integer or **Whole Number** is one composed of whole units; as 12, \$7, 8 *feet.*

7. A Fraction is one or more of the equal parts of a unit; as $\frac{3}{4}$, $\frac{1}{2}$ *yd.*, \$$2\frac{3}{5}$.

8. A Mixed Number is one composed of an integer and a fraction; as, $1\frac{2}{3}$, $7\frac{1}{4}$ *ft.*, \$$3\frac{1}{2}$, \$4.25.

9. Arithmetic is the science of numbers, and the art of using them in making calculations.

To the Teacher: Read carefully the suggestions on pages 3 to 6. The work in the *First Part* provides the necessary induction to these definitions.

10. Notation is the art of writing numbers.

There are in common use two methods of notation, the Arabic and the Roman.

11. The Arabic Method of Notation is one in which numbers are expressed by means of the figures 1, 2, 3, 4, 5, 6, 7, 8, 9 and 0.

12. Numbers are written in the Arabic notation according to a plan called **The Decimal System**, in which ten units of any order make one of the next higher.

13. An Order or **Place** is the position which a figure in a number occupies.

Orders are arranged in a horizontal line in groups called periods.

14. A Period is a group of three orders of integers.

Orders are counted into periods from the right hand.

15. The Decimal Point (.) is used to fix the position of *ones* or *primary units*. It is always written or understood at the right of *ones*.

Higher orders are always found at the left of lower orders.

Places on the left of the decimal point are occupied by *integers*, those on the right by fractional parts of one called *decimals*.

16. Table of Orders and Periods. —

Etc.	Hundred-bill.	Ten-billions	Billions	Hundred-mill.	Ten-millions	Millions	Hundred-thous.	Ten-thousands	Thousands	Hundreds	Tens	*Ones*	*Decimal point*	Tenths	Hundredths	Thousandths	Ten-thousandths	Hundred-thous.	Millionths,	Ten-millionths	Etc.
	8	3	7	9	4	1	0	4	8	6	3	5	.	3	7	5	9	7	4	2	
	Billions Period.			Millions Period.			Thousands Period.			Units Period.											

The orders of a decimal are counted into periods *as integers*.

17. Numeration is naming the orders and periods used in writing a number.

18. Principles of Decimal Notation. —

I. Ten units of any order equal one unit of the next higher order.

10 *ones* = 1 *ten*, 10 *tens* = 1 *hundred, etc.*
10 *thousandths* = 1 *hundredth*, 10 *hundredths* = 1 *tenth, etc.*

II. One unit of any order equals ten units of the next lower order.

1 *thousand* = 10 *hundreds*, 1 *hundred* = 10 *tens*, etc.
1 *tenth* = 10 *hundredths*, 1 *hundredth* = 10 *thousandths*, etc.

III. Removing the decimal point in any number one place to the right, makes the number ten times as great.

If, in the number $2.50, the decimal point be removed one place to the right the number becomes $25.00, or ten times $2.50.

IV. Removing the decimal point in any number one place to the left makes the number one tenth as great.

If, in the number $60., the decimal point be removed one place to the left, the number becomes $6., or one tenth of $60.

V. Annexing decimal ciphers to any number does not change its value.

$5. = $5.00; 2.5 = 2.50; .5 = .50, .500, etc.; 36 = 36.0, 36.000, etc.

VI. Omitting decimal ciphers from the right of any number does not change its value.

$7.00 = $7.; .50 = .5; 2.3700 = 2.37.

19. In Reading Numbers. —

I. Integers: *Begin at the left, read each period as though it stood alone, adding the name of the period, except it be units period.*

II. Decimals: *Read the number as though it were an integer, adding the name of the lowest order.*

In Writing Numbers. — *Write each figure in the place for that order, marking the unoccupied places by ciphers.*

NOTES. I. In reading numbers, do not say '*and*' after hundreds. Incorrect names are often given to the orders; for instance, *ten-thousandths* are often called *tens of thousandths*, or *tenths of thousandths*. See the Table. 2. In writing numbers, it is not advisable to separate periods by commas or other marks.

20. United States Money (Art. 207) is written on the decimal plan. The primary unit is the *Dollar* ($).

10 *mills* equal 1 *cent* (*ct.*),
10 *cents* " 1 *dime*,
10 *dimes* " 1 *dollar*.

Dollars are written as *integers*, Dimes as *tenths*, *Cents* as *hundredths*, and Mills as *thousandths* of a dollar.

Dimes and cents are read together as cents (hundredths), and mills as mills or as parts of a cent.

21. Examples. — Read the following: (S. 6.)

1. 786
2. 908
3. 3086
4. 5704
5. 8060
6. 7009
7. 47583
8. 92480
9. 70504
10. $7.54
11. $8.05
12. $12.60
13. 5.5
14. 7.25
15. 8.07
16. 3.705
17. .375
18. .0753
19. $70.60
20. $.75
21. $8.375
22. 37508
23. $\$9.08\frac{1}{3}$
24. 80.1625
25. $4.065
26. 30059
27. $\$9.43\frac{3}{4}$
28. .587
29. 500.087
30. $109.08
31. $1.0625
32. 9053.07
33. $.1875
34. .0245
35. $59.625
36. 405809

Write in figures the following: (S. 6.)

1. Ten thousand seven hundred six.
2. Ninety thousand one hundred seven.
3. Five hundred thousand four hundred eighty.
4. Six hundred fifty thousand forty-three.
5. Nine million eight thousand seventeen.
6. Twenty-four hundred and forty-two ten-thousandths.
7. Thirty-one hundred forty-two ten-thousandths.
8. Four hundred sixty-eight thousandths.
9. Four and twelve hundredths.
10. Two and five hundred seventy thousandths.
11. Three hundred and sixty-eight thousandths.
12. Sixteen dollars and sixty cents.
13. Fifty dollars sixty-two cents five mills.
14. Eighty-six dollars twelve and a half cents.
15. Three dollars forty-six and one fourth cents.
16. Twelve dollars sixteen and two thirds cents.
17. Five dollars thirty-three and a third cents.

II. ADDITION.

22. Addition is the process of finding how many there are in two or more numbers taken together. (S. 7.)

The number found by addition is the **Sum** or **Amount.**

23. Principals. — *I. Like numbers only may be added.*

II. Tens of any order make ones of the next higher order..

24. In adding Decimals and U. S. Money, the decimal points are usually arranged in a column.

25. Exercises. — (S. 4 and 5.)

1. How many are \$15 and \$8? 15 tens and 8 tens? 150+80?

2. Add 7, 9 and 6; 70, 90 and 60; 75, 98 and 68.

3. Count by *threes* from 3 to 63; by *fours*.

4. Count by *fives* from 2 to 52; from 4 to 54.

5. 30+50+30+80=? 6. 35+50+45+26=?

7. How many are \$20 and \$36? 58 ft. and 35 ft.?

8. There are 28 pupils in one class, 33 in another, 18 in a third, and 24 in a fourth; how many in all?

9. Write the numbers 65 to 75 in a column; add them.

10. Add \$.25, \$.32 and \$.28 without writing the numbers.

26. 1. Count by *fives* from 3 to 93; by *sixes*.

2. Add 15 and 9; 150 and 90; 55 and 75.

3. Add 17, 22, 14 and 35 without writing.

4. A farmer bought 17 horses, and had twice as many before; how many has he now?

5. A boy paid 45 cents for a reader, 30 cents for a slate, and 45 cents for an arithmetic; how much for all?

6. Add 7215, 989, 7896, 2987, 765, 9386 and 7088.

7. Add 82.5, 9.305, 16.87, 98.09, 83.8 and 7.069.

8. A man traveled 176 miles by rail, 183 by stage, and 108 on horseback; how far in all?

9. \$76 are \$28 less than how much?

10. Write the numbers 33 to 42 on a *line;* add them.

27. 1. Add 8, 12 and 7; 80, 120 and 70; 85, 28 and 78.

2. Count by *sevens* from 5 to 89; from 3 to 80.

3. Count by *eights* from 4 to 84; from 7 to 87.

4. If I earn $27 one week, $19 the next, and the third as much as in both the others, how much do I earn in all?

5. A man sold a horse which cost $135, at a gain of $28; find the selling price.

6. I paid $26 for a harness, for a horse $74 more than the harness, and for a cart as much as for both the horse and harness; how·much for all?

7. A farmer sold 321 bushels of wheat, 238 bushels of oats, 368 bushels of corn, and as many bushels of barley as of oats and corn; how many bushels in all?

8. A lot cost $750, the house on it $3875; both were sold at gain of $675; find the selling price.

9. Add $9.63, $15.48, $9.54, $6.17, $8.56 and $18.39

10. $253 are $88 less than how much?

28. 1. Count by nines from 7 to 97; from 5 to 86.

2. Add $.35, $.52 and $.26 without writing the numbers.

3. B is 28 years old; how old will he be in 18 years?

4. John spent 45 cents and has $1.35 cents left; how much had he at first?

5. If you sell a box of tools for $8.75, a saddle for $9.50, and then earn $7.60, how much will you have?

6. A sold 756 head of cattle to one party, 478 to another, and had 896 left; how many had he at first?

7. What cost a barrel of flour at $9.75, a sack of potatoes at $1.25, a cheese at $4.60, and a bucket at $1.75?

8. A merchant's sales were $437.50 on Monday, $376.35 on Tuesday, $385.90 on Wednesday, $418.57 on Thursday, $327.50 on Friday, and $483.56 on Saturday; how much for the week?

9. Bought a wagon for $156, a horse for $75.50, and a harness for $27.75; how much did all cost?

10. Add 72.5, 3.09, 54.75, 17.9, 8.875, and 56.58.

29. 1. Count by *sixes* from 5 to 89; by *sevens*.

2. John paid 85 cents for a slate and $1.35 for a geography; how much did both cost?

3. In a school there are 123 boys and 28 more girls than boys; how many pupils are there in all?

many pupils are there in all?

4. Sold a watch for $15, losing $8; for how much should it have been sold to gain $8.50?

5. A boy paid $5.50 for a sheep, and for a pony $24.50 more than the sheep; how much did both cost?

6. A grocer sold a barrel of apples for $2.45, losing $1.35; how much did they cost?

7. A man paid $.75 for a book, $1.45 a hat, $18.50 for a coat, and $5.80 for a pair of shoes; how much for all?

8. Tom has $3.15, Dick has $5.70, and Harry has $2.50 more than Tom; how much have they all?

9. Add the numbers from 896 to 907 inclusive.

10. Add $7.56, $9.17, $12.78, $8.52, $9.45 and $38.56.

30. 1. Count by *eights* from 5 to 77; by *nines*.

2. How many days in April, May, June and July.

3. A lady bought 2 dozen eggs at 45 cents a dozen, a can of fruit for 20 cents, and a pound of starch for 12 cents; what was the amount of the purchase?

4. A coal dealer sold 356 tons of coal to one party, 478 tons to another, 587 tons to a third, and had 789 tons left; how much had he at first?

5. May is 14 years old, her mother is 28 years older than she, and her grandmother is 27 years older than her mother; how old is her grandmother?

6. A farmer sold five loads of hay, weighing 1680 pounds, 1496 pounds, 1885 pounds, 1745 pounds, and 1749 pounds; how much did the whole weigh?

7. Write the amounts, $5.86, $2.45, $3.20, $7.05, $4.35, and $2.64 in a *line*, and add them. (S. 7.)

8. Lost $8.75 on a watch sold for $35.50; find the cost.

9. Add the numbers 76 to 90 inclusive.

10. $837 are $356 less than how much?

31. 1. Count by *sevens* from 4 to 67; by *nines*.

2. There are at work in a shop 19 men, 17 women, and 22 children; how many persons work in the shop?

3. A lady paid $3.25 for a pair of shoes, $1.25 for a pair of gloves, and $.85 for muslin; how much for all?

4. Four men are worth respectively $8500, $9600, $6750 and $10850; how much are they all worth?

5. A trader sold a house and lot for $8570, losing $850; find the cost.

6. A has $1875, B has $285 more than A, and C has as much as A and B together; how much have all?

7. Add $7.56, $9.17, $28.79, $9.32, $17.54, $9.45 and $38.56.

8. $18.37 were taken from how much to leave $56.75?

9. $4835 are $2385 less than how much?

10. A man was born in 1732, and lived 67 years; in what year did he die?

11. Add 5378, 9485, 67015, 9438, 70548, 9007, 2836, 76078, 35943 and 68599.

32. 1. Add 7.36, 93.2, 63.08, 15.725, 83.75 and 92.8.

2.	4.	6.	8.	9.	10.
784	983 lb.	$ 7.85	315	7854	$ 79.68
589	589	9.08	87	85908	43.27
678	97	33.27	59	7094	9.85
796	864	12.72	826	39650	40.23
578	786	18.56	128	17087	212.27
			920	8639	93.28
3.	5.	7.	584	69584	66.93
879	987 ft.	$28.90	439	87596	15.81
796	3386	13.75	87	9487	70.35
88	978	49.37	295	7679	381.26
309	2796	16.28	76	49085	93.78
983	1909	24.72	209	5978	75.23
98	787	18.77	587	76878	239.18
757	1239	9.35	759	5946	56.87
584	896	27.59	97	8359	84.19

III. SUBTRACTION.

33. Subtraction is the process of taking one number from another.

The number found by subtraction is the **Difference** or **Remainder**; the number from which another is taken is the **Minuend**; the number taken from another is the **Subtrahend.**

34. Principles. — *I. A number may be taken from a like number only.*

II. One of any order makes ten of the next lower order.

III. The remainder and subtrahend together equal the minuend.

35. In subtracting *Decimals* and *U. S. Money*, the decimal point in the subtrahend is placed under that of the minuend.

36. Exercises. — (S. 4 and 5.)

1. How many are 9 less 4? 90 less 40? 95 —45?

2. How many are 15 less 8? 150—80? 160—85?

3. Tom is 16 years old; how old was he 9 years ago?

4. I sold a pony for $33, gaining $8; find the cost.

5. How many are $80 less $20? $80—$24? $83—$28?

6. What number added to 18 will make 40? 46?

7. Two barrels of sugar weigh 486 pounds; one weighs 220 pounds; how much does the other weigh?

8. A horse which cost $150, was sold for $135; find the loss.

9. A man bought a coat for $12.75, and a hat for $4.50; he handed the dealer a 20-dollar bill, how much did he get in change?

10. A man having $90.75, lacks how much of having enough to purchase a watch and chain worth $125?

11. If I have 175 sheep and buy 78 more, how many do I lack of having 300?

37. 1. Count off *fours* from 63 to 3; *fives.*

2. How many are 14 less 8? 140 less 80? $240—$80?

3. How many are 75 less 9? 750—90? 750—190?

4. How many are 20 less 6? $2 less $.60? 200—65?

5. A farmer having 25 horses, sold 9 at one time and 7 at another; how many had he left?

6. A farm which cost $7500, was sold for $9750; find the gain.

7. A clerk earns $950 a year; he pays $360 for board, and $295 for other expenses; how much may he save?

8. What sum added to $25.25 gives $102?

9. From 7038 take 5947. 10. Take $90.58 from $250.25.

38. 1. Count off *sixes* from 87 to 3; *sevens.*

2. A lady went shopping with $20; her purchases amounted to $11.75; how much had she left?

3. I sold a sled costing $3.50, for $2.65; find the loss.

4. Take the sum of $48 and $24.60 from $95.

5.	6.	7.	8.	9.
1593	2708 bu.	$96.12	736.5	$368.32
876	1567	49.73	580.37	197.625

10. $18.30 are $7.56 more than how much?

39. 1. Count off *eights* from 79 to 7; *nines.*

2. How many are 13 less 7? 130—70? 132—75?

3. $78 are $5 more than how much? $35 more than what?

4. 36 ft. are how many less than 40 ft.? less than 95 ft.?

5. A cow cost $37.50; she was sold for $45; find the gain.

6. A watch cost $42.75, the chain $15.50; what was the gain, if both were sold for $75?

7. A man bought a horse for $165, and a carriage for $243.75; he paid $250 down, and gave his note for the balance; for how much was the note given?

8. Take $23.67 from $68.43. Make a problem. (S. 5.)

9. From 73049 take 59568. 10. Take 80.75 from 136.5.

11. What number taken from 7506 leaves 2960?

12. $83.56 are $29.58 less than how much?

40. 1. Count by *sevens* from 6 to 69; by *nines.*

2. Mary raised 38 chickens; she sold 9, and gave away 7; how many had she left?

3. Sam had $.45 and earned $.24; he then spent $.38 and lost $.17; how much had he left?

4. A man died in 1883, aged 50 years; when was he born?

5. By selling flour at $9.25 per barrel, $1.60 is gained; how much did it cost per barrel?

6. A and B have 759 sheep; B lacks 257 of having 490; how many has A?

7. From 53727 take 49593. 8. Take $78.54 from $92.

9. Take $57.45 from $84.37. 10. From 73007 take 54729.

41. 1. Count off *sevens* from 68 to 5; *nines.*

2. $87 less $24 are how many? 97—42? 85—29?

3. A boy having $.60, earned $.75, then spent $.80; how much had he left?

4. In a school there are 67 girls and 49 boys; how many more girls than boys? how many pupils in all?

5. If I buy one cow for $42, and another for $56, then sell them, gaining $12 on the first and $14 on the second, how much do I get for them?

6. From 80705 take 63592. 7. From $73 take $48.29.

8. Take 29390 from 41376. 9. Take $35.27 from $67.40.

10. $33.46—$18.70=? Make a problem for this example.

42. 1. Count by *eights* from 5 to 77; by *sixes.*

2. $125 less $30 are how many? $115—$45? $115—$38?

3. A man sold a cow for $40 and a horse for $85; after spending $60 of the money, how much had he left?

4. If I buy at a market some apples for $.65, some cheese for $.55, and some butter for 40 cents, how much change will I get for a 2-dollar bill?

5. Take $7.95 from $14.50. Make a problem.

6. $23.40 are $17.65 more than how much.

7. How much had I left of $71 after spending $38.45?

8. From $73.50 take $48.85. 9. Take $76.45 from $94.

10. $89.75 are how much less than $106.15?

43. 1. A farmer had 56 sheep in one field, and 42 in another; he sold 18 from each; how many had he left?

2. A clerk earns $65 a month, and his expenses are $38 a month; how much may he save?

3. A farmer raised 32 horses, bought 25 more, then sold all but 18; how many did he sell?

4. A grocer bought a barrel of flour for $9.55, and a barrel of sugar for $28.85; he sold both for $42; how much did he gain in the transaction?

5. Take 8754 from 56395.   6. From $67.10 take $35.28.
7. From 85426 take 73908.   8. Take $38.65 from $72.40.
9. (43+29)—(36+15)=?   10. ($7.25+$3.47)—$8.90=?

44. 1. Count by *sixes* from 5 to 95; by *nines*.

2. Count by *sevens* from 3 to 59; by *eights*.

3. How many are 68 bu. less 35 bu.? 680 bu. less 350 bu.?

4. How many are 70 less 30? $780 less $350?

5. Tom and Dick together have $62; Tom has $14 more than Dick; how much has each?

6. A lady went shopping with $24; she paid $12.65 for a dress, and $7.50 for a hat; how much had she left?

7. From a 63-gallon cask of sirup, 17 gallons were drawn at one time, and 25 at another; how much remained?

8. $18—($3.50+$9.75)=? Make a problem.

9. Take $73.65 from $92.25.   10. From 80360 take 65492.

45. 1. Count off *eights* from 71 to 7; from 68 to 4.

2. Count off *nines* from 70 to 7; from 67 to 4.

3. 297 yards are 365 yards less than how many?

4. 581 bushels are 367 bushels more than how many?

5. How much added to $17.54 will make $31.50?

6. A merchant having $7560, gained $1585, then lost $3564; how much had he left?

7. Mr. Nye bought a farm for $6750, and a city lot for $875; he sold both for $7800; find his gain.

8. $73.50 were added to how much to make $105?

9. ($17.50+$12.90)—$263.5=? Make a problem.

10. $37.50—($18.25+$7.75)=? Make a problem.

IV. MULTIPLICATION.

46. Multiplication is a process of finding the amount of several equal numbers. (S. 8.)

The number found by multiplication is the **Product**; the one of the equal numbers multiplied is the **Multiplicand**; the number showing how many equal numbers are taken to form the product is the **Multiplier.** The multiplicand and multiplier are the **Factors** of the product.

The product of *two* equal factors is a **Square,** — thus, 9 is the square of 3; the product of *three* equal factors is a **Cube,** — thus, 27 is the cube of 3.

One of the *two* equal factors of a number is the **Square Root** of the number, — thus, 5 is the square root of 25; one of the *three* equal factors of a number is the **Cube Root** of the number, — thus, 2 is the cube root of 8. (S. 8.)

47. Principles. — *I. The multiplier is always an abstract number.*

II. The multiplicand and product are like numbers.

III. The product is the same whichever factor is used as the multiplier.

48. In multiplying *Decimals* and *U. S. Money* there are as many decimal places in the product as in both factors.

49. Exercises. — (S. 4 and 5.)

1. How many are 7 dozen? 10 dozen? 20 dozen?
2. What cost 8 books at 15 cents each? at 30 cents?
3. How many are 9 times 8 yards? 9×80 yards?
4. What cost 12 yd. of cloth at $.20 a yard? 50 yd.?
5. 365 days make a year; how many days in 9 years?
6. From 6 times $9.45, take $36.75.
7. At $.75 a yard, what cost a fence 64 yd. long?
8. From $73.85 take $61.58. 9. Multiply 768 by 74.
10. Add 7685, 908, 579, 4280, 795, 879 and 8796.

50. 1. What cost 12 books at $.80 each? at $.75?

2. What cost 15 lb. of coffee at $.20 a pound? 25 lb.?

3. How many are 10 times 16 cents, +27 cents? (S. 8.)

4. What cost 7 tons of hay at $15 per ton?

5. John bought 9 marbles at 5 cents each, and had 35 cents left; how much had he at first?

6. What is the value of 24 cows at $75 each?

7. There are 36 inches in a yard; how many in 39 yd.?

8. Add $758, $89, $347, $658, $937, $968 and $876.

9. Multiply 936 by 745. 10. From $87.36 take $49.75.

51. 1. How many days in 8 months of 30 days each?

2. How many ounces in 10 pounds? 15 lb.? (Table page 82.)

3. How many pounds in 4 tons? 10 tons?

4. What cost 1 lb. 4 oz. of nutmegs at 10 cents per oz.?

5. At $12.25 per ton, what cost 28 tons of hay?

6. How many ounces in a barrel of flour, 196 lb.?

7. What cost 56 boxes of oranges at $4.35 per box?

8. Find the value of 139 sheep at $3.50 per head.

9. What cost 18 pieces of cloth, 36 yd. each, at $.38 a yard?

10. A school bell contains 378 lb. of tin and 7 times as much copper; what is the weight of the bell?

52. 1. How many pints in a gallon? (Table, page 85.)

2. What cost 3 gallons of milk at 8 cents a quart?

3. A milkman buys milk at 16 cents a gallon, and retails it at 5 cents a quart; find his gain on 24 gal.

4. Five men build a fence in 6 days; how many days' work are required? How long should it take 10 men?

5. What cost 18 pairs of boots at $8.65 per pair, and 24 pairs of shoes at $4.30 per pair?

6. $(8\times\$56)+(17\times\$37.50)=?$ Make a problem.

7. How many gallons of oil in 78 casks, each containing 49 gallons?

8. From $76.25 take $57.33. 9. Multiply $9.375 by 64.

10. Add 87, 368, 947, 79, 485, 8567, 794 and 599.

11. From the sum of 1938 and 876 take their difference.

12. Write the numbers 37 to 46 in a *line;* add them.

53. 1. How many quarts in 7 gallons? 17 gallons?

2. What cost 10 lb. of coffee at 16 cents a pound? 15 lb.?

3. At $8 a ton, what cost 8 tons of coal? 80 tons?

4. Find the value of 9 building lots at $90 each; at $75.

5. What cost 250 barrels of pork at $20 per bbl.? (S. 8.)

6. What is the cost of 8 pieces of cloth, each containing 38 yards, at $3.20 per yard?

7. A book-keeper earns $85 a month; his expenses are $41.75 a month; how much may he save in a year?

8. If I live 37 years longer, I shall be 76 years old; how old was I 29 years ago?

9. Multiply 9876 by 28. 10. Take $38.27 from $105.

54. 1. How many are 10×30? 20×30? 20×35?

2. How many pecks in 12 bushels? in 25 bu.? (Table p. 84.)

3. What cost 5 bushels of apples at $.25 a peck?

4. A man has 26 sheep, buys 19 more, then sells them all at $5 each; how much does he get for them?

5. I paid $2.70 for books, $1.65 for a hat, $18.40 for a coat, and $4.85 for shoes; how much for all?

6. A man 37 years old died in 1883; when was he born?

7. What sum taken from $90.25 will leave $36.68?

8. Add 378, 5783, 679, 465, 7345, 867, 3956 and 789.

9. Take 73086 from 90549. 10. Multiply 8736 by 59.

55. 1. What cost 7 tons of hay at $8 a ton? at $8.50?

2. How many inches in 10 yards? (Table, p. 86.)

3. Tom has 19 marbles; Harry has 5 times as many less 40; how many have both?

4. How many feet in 3 miles? how many yards?

5. $18.75×7=? Make a problem for this example.

6. A dealer bought 9 tons of iron at $5.65 per ton, and sold it at $8.25 per ton; how much was gained?

7. What was the weight of 9 chests of tea, weighing 58, 63, 54, 62, 49, 53, 58, 57 and 65 pounds?

8. Add $17.65 and $39.48, and take $28.76 from the sum.

9. Multiply 9376 by 837. 10. Multiply $3.08 by 176.

11. ($5.75×9)—$46.50=? Make a problem.

56. 1. How many are 8 times 25? 9×70? 9×75?

2. How many are 8 times 60? 8×60,+36? (S. 8.)

3. How many minutes in 4 hours 36 minutes? (Table, p. 90.)

4. How many hours in a week? in 4 weeks?

5. What cost 9 spellers at $.25 each? 20 spellers?

6. How many minutes in a day? seconds?

7. What cost 320 barrels of flour at $9.20 per bbl.?

8. How far will a ship sail in 58 days, at the rate of 265 miles a day?

9. 75 sheep cost $250, and were sold at $4.25 a head; how much was gained?

10. Sold 9 horses at $85 each; lost $195; find the cost.

57. 1. How many are 8 times 90? 8×96?

2. What cost 8 pairs of shoes at $4.50 a pair?

3. How many are 6 times 307? 3 times 325?

4. How many days in the first 5 months of the year?

5. How many days from Washington's Birthday to the Fourth of July?

6. In 27 years how many days?

7. $19.58 were taken from what sum to leave $56.75?

8. The loss on a harness sold for $22.40 was $8.75; what was the cost?

9. Multiply $9.65 by 100. 10. $.935 multiplied by 48=?

58. 1. At $7.50 per ton, what cost 8 tons of coal?

2. How do you multiply any number by 100? by 200?

3. How many hours in 3 days and 17 hours?

4. How many inches in 3½ yards?

5. What cost 7 gal. 2 qt. of milk, at 3 cents a pint?

6. What cost 9 lb. of tea at 45 cents a pound, and 7 lb. of butter at 33 cents a pound?

7. At $1.75 a rod, what will a mile of fence cost?

8. A's farm is worth $7800, B's is worth twice as much; how much are both worth?

9. How many days in four years and 289 days?

10. $27 are how much more than $18.63?

11. $47.79 are $53.68 less than how much?

V. DIVISION.

59. Division is a process of finding how many times one number is contained in another of like kind, or of finding one of the equal parts of a number. (S. 2 and 9.)

The number found by division is the **Quotient**; the number divided, or separated into equal parts, is the **Dividend**; the number by which the dividend is divided, or which shows how many equal parts there are in the dividend, is the **Divisor**; there may be a **Remainder**.

One of the *two* equal parts of a number is *one half* ($\frac{1}{2}$) of it; one of the *three* equal parts of a number is *one third* ($\frac{1}{3}$) of it; three of the *four* equal parts of a number are *three fourths* ($\frac{3}{4}$) of it; etc.

60. Principles. — *I. The divisor and quotient are factors of the dividend.*

II. Omitting or canceling a factor from a number, divides the number by that factor.

III. If both divisor and dividend be multiplied by the same number, the quotient is not changed.

IV. If both divisor and dividend be divided by the same number, the quotient is not changed.

61. In division of Decimals and U. S. Money, the number of decimal places in the dividend is made to equal or exceed the number in the divisor; the quotient contains as many decimal places as the number in the dividend exceeds the number in the divisor (Art. 229.).

62. Exercises.—

1. How many sheep at $7 each cost $63?
2. 5 watches cost $125; how much did each cost?
3. How many 9-dollar hats will $85 buy?
4. How many feet in 100 inches?
5. At $25 a ton, how many tons of iron cost $1975?
6. ($37.25×38)—$680.50=? 7. (568×39)÷54=?

63. 1. How many stoves at $10 each, cost $210? (S. 9.)

2. If you have $2.50, how many 25-cent books can you buy?

3. Four clocks cost $75; what was the price of each?

4. Seven mules cost $350; how much did each cost?

5. Find $\frac{1}{8}$ of $88. Make a problem for this example.

6. How many sq. yd. in 120 sq. ft.? (Table, page 87.)

7. How many sq. yd. in a floor 12 ft. by 15 ft.? (S. 10.)

8. How many tons of coal at $7 a ton, are worth as much as 14 cords of wood at $5 a cord?

9. What cost 18 pairs of boots at $7.50 per pair, 9 pairs at $6.65, and 10 pairs at $9.85?

10. Find $\frac{1}{8}$ of the sum of $17.54 and $29.86.

11. What cost 3 bu. of plums at 5 cents a quart?

64. 1. How many bushels in 119 quarts?

2. Tom had $2; he spent $\frac{1}{4}$ of it for a slate, and $\frac{1}{2}$ of the remainder for a knife; how much had he left?

3. A train runs at the rate of 18 miles per hour; how far will it run in $\frac{3}{4}$ of a day?

4. 6 bbl. of flour cost $51; find the price per bbl.

5. At $9 each, how many dictionaries cost $540?

6. A drover sold 32 beeves for $1750; what was the average selling price per head?

7. How many yards in 8500 ft.? in half a mile?

8. What sum multiplied by 29 gives $1682?

9. Divide 15807 by 87. 10. Find $\frac{1}{45}$ of 98546.

65. 1. Find $\frac{1}{10}$ of 783; of $83; $\frac{1}{100}$ of 2586; of $7.50.

2. 6 men build a house in 10 days; how long should it take 8 men?

3. How many pounds in 1000 oz.? in 2 tons and 76 lb.?

4. How many days in 360 hours?

5. From 19873 take 16958. 6. Multiply $9.45 by 207.

7. Divide 83763 by 78. 8. Divide $57 by $.25.

9. $91÷$.35=? Make a problem for this example.

10. How many cu. yd. in 585 cu. ft.? (Table, page 88.)

11. At $54 per acre, how many acres of land cost $5670?

12. How many sq. ft. in 1780 sq. in.? (Table, page 87.)

66. 1. In 89 days how many weeks? how many hours?

2. How many 8-quart cans will 15 gal. 3 qt. of milk fill?

3. At $.09 a pound, how many pounds of beef cost $1.08?

4. How many sq. yd. in 100 sq. ft.? how many sq. in.?

5. At $.25 each, how many penknives cost $3.50?

6. A farmer harvested 2096 bushels of oats from 44 acres of land; what was the average yield per acre?

7. $7500 were paid for 160 acres of land; what was the price per acre?

8. 3967÷75 10. $7954÷86 12. 37724÷318
9. 8075÷93 11. $8776÷$38 13. 93765÷298

67. 1. At $.30 each, how many books cost $1.50?

2. Will had 14 marbles; he said to Tom, "Give me $\frac{1}{3}$ of yours, and I shall have 25;" how many had both?

3. How many gallons in 110 pints?

4. How many tons in 18500 pounds?

5. What cost 46 cords of wood at $6.75 a cord?

6. If I sell 875 lb. of wool at $.35 a pound, and invest the money in cloth at $.45 a yard, how many yards do I buy?

7. I exchange 540 bushels of wheat, at $1.35 a bushel, for oats at $.45 a bushel; how many bushels do I get?

8. 747621÷427 9. 32857÷380 10. 32756÷585

68. 1. If 5 oranges cost $.50, how much will 12 cost?

2. A man bought a horse for $125, and sold it at a gain of $\frac{1}{5}$ of the cost; find the selling-price.

3. If I can walk 32 miles in 8 hours, how far can I walk in 10 hours?

4. A buys 29 horses at $128 each, and sells them at $165 each; how much does he gain?

5. Bought 547 yards of cloth at $3.75 a yard; for how much must it be sold to gain $175?

6. How many books at $.75 each cost $12.50?

7. At $.21 each, how many boxes cost $52.50?

8. Take $176.30 from $258.

9. Multiply $39.86 by 46.

10. Find $\frac{1}{28}$ of 9740. 11. Divide 97836 by 3086.

69. 1. I have $3; how many 15-cent books can I buy?

2. Seven times $12 are how many times $8?

3. How many bushels in 8 bags, each containing 6 pecks?

4. I bought wood at $4 a cord, and sold it at $7 a cord, gaining $21; how many cords did I buy?

5. How many sheep at $9 each can you buy with $85?

6. How many sacks, each holding 2 bu. 2 pk., may be filled from 10 bu. 3 pk. of oats? (Table, page 83.)

7. Divide 6825 by 10; by 100; by 1000.

8. I bought a horse for $185; after paying $37.60 for keeping him, I sold him for $240; find the gain.

9. Divide $78.90 by $.30. 10. Divide 39576 by 408.

70. 1. How many papers, at 3 cents each, cost $2.40?

2. Five barrels of flour are worth $40; how many yards of cloth at $3 a yard will six barrels pay for?

3. A clothier bought 10 coats for $65, and sold them at $8.50 each; how much did he gain?

4. Seven times 15 feet are how many times 8 feet?

5. How many 'nickels' are equal in value to $3.25?

6. Bought 20 tons of coal at $7.50 a ton, and 9 cords of wood at $4.75 a cord; find the whole cost.

7. Add $7.83, $18.56, $12.65, $9.48, $8.37, $7.68 and $8.59.

8. At $1.75 each, how many hats cost $56?

9. Divide 3.225 by .43. 10. Divide 347904 by 768.

71. 1. What cost 12 pencils when 8 cost 40 cents?

2. What cost 90 yards of cloth when 7 cost $.77?

3. What is the average weight, when 7 boxes weigh 840 lb.?

4. If $60 will buy 8 books, how many will $15 buy?

5. $3.75 are $\frac{1}{7}$ of how much? 6. $(\$.17 \times 96) \div \$.14 = ?$

7. If 16 desks cost $84, how many cost $105?

8. I sold a saddle for $20.75, and a horse for 24 times as much lacking $108.25; how much were both sold for?

9. A train runs 444 miles in 12 hours; in how many hours would it run 555 miles?

10. Take 27 times $4.92 from [illegible]7 times $5.76.

11. How many square yards in a floor 16 ft. by 18 ft.?

72. 1. What cost 30 caps at $15 a dozen?

2. A farmer bought 47 sheep, then sold 34 and had 35 left; how many had he at first?

3. A man earns $65 a month; his expenses are $31.60 a month; how much may he save in 8 months?

4. 7 times 25 cents are how many times 10 cents?

5. How many pounds of coffee, at $.18 a lb., cost $17.28?

6. How many cubic yards in 396 cu. ft.? (Table, page 88.)

7. What cost 48 yards of cloth at $1.625 a yard?

8. Add $9.74, $8.69, $12.76, $9.47, $8.46, $8.57, $9.72, $3.94, $11.68, $13.94, $5.76, $8.92 and $16.52.

9. From $77.58 take $56.83. 10. Find $\frac{1}{17}$ of $49.30.

73. 1. How many books, at $.40 each, cost $4.80?

2. Find $\frac{1}{8}$ of 84; $\frac{3}{8}$ of 80; $\frac{5}{12}$ of $3.

3. How many feet are there in 780 inches?

4. How long should it take 9 men to build as much fence as 5 men build in 12 days?

5. Bought 9 bbl. of apples at $5.25 per bbl., and sold them at $4.40 per bbl.; find the loss.

6. A lady bought 27 yd. of velvet at $3.25 a yard; she handed the clerk a 100-dollar bill; how much did she get in change?

7. From $75.18 take $56.35. 8. Multiply 9.37 by 7.2.

9. Divide 73446 by 360. 10. Find $\frac{3}{14}$ of 90902.

74. 1. How do you find 5 ninths of a number?

2. 24 feet are 3 fifths of how many feet?

3. 42 cents are 6 elevenths of how much?

4. 7 times $12 are how many times $9?

5. How many mules at $85 each are worth as much as 34 horses at $125 each?

6. 16.5 feet make 1 rod; how many rods in 74.8 ft.?

7. How many lb. of tea at $.25, are worth as much as 25 doz. eggs at $.18, and 12 lb. of butter at $.375?

8. $3064.32 were paid for 76 chests of tea, 56 pounds each; what was the price per pound?

9. 6 cords of wood cost $25.50; what cost 7.5 cords?

75. 1. John said, "I spent $\frac{2}{3}$ of my money, and have $.15 left;" how much had he at first?

2. At 9 cents a dozen, how many dozen eggs will pay for 12 yards of cloth at 12 cents a yard?

3. $27 are $\frac{1}{9}$ of how much? $\frac{3}{5}$ of how much?

4. How many square feet in 21 sq. yd.?

5. Add 976, 1585, 9374, 7643, 1859, 4238, 7635, 869, 1637, 3095, 5769, 7408 and 3579.

6. 9 bu. of onions sell for how much, at $.60 a peck?

7. How many tons of hay, at $18.75, sell for $525?

8. ($18.75×28)÷$.42=? Make a problem.

9. $57.50÷$.25=? 10. Multiply $9.45 by 207.

76. 1. How many months in 240 days?

2. If I earn $55 a month, and my expenses are $30 a month; how much may I save in 8 months?

3. A man gave a cow and $15 for a horse valued at $90; how much did he get for his cow?

4. If I have $2.50, and pay all but $1.15 for cloth at 10 cents a yard; how much do I buy?

5. What cost 9 sets of tools at $18.70 a set?

6. Tom has $5.35; he owes Dick $2.25 and Harry $1.40; if he pay them, how much will he have?

7. Take 37086 from 74590. 8. Multiply $73.25 by 19.

9. Divide $7.80 by $.19. 10. Find $\frac{1}{16}$ of 4645.

77. 1. I paid 72 cents for a dozen pencils; how much will I gain by selling them at 10 cents each?

2. How many square rods in 5 acres?

3. How many cubic feet in 10 cubic yards?

4. How many dozen eggs, at 6 cents a dozen, will pay for 8 yards of cloth, at 15 cents a yard?

5. How many yards in half a mile? in 18 miles?

6. How many 5-cent penholders cost $2?

7. Divide 73648 by 529. 8. Divide 78349 by 790.

9. Paid $8568 for a farm, and sold it at a gain of $\frac{1}{17}$ of the cost; find the selling price.

10. How many yards in 78 miles?

VI. FACTORS, DIVISORS AND MULTIPLES.

78. In the expression $5 \times 7 = 35$, each of the numbers, 5 and 7, is a *factor* of 35; in like manner 2, 3 and 5 are factors of 30. In the expressions $35 \div 7 = 5$, and $35 \div 5 = 7$, each of the numbers, 5 and 7, is a *divisor* of 35; in like manner 2, 3 and 5 are divisors of 30.

It is seen that 5 is both a factor and a divisor of 30, — that is, *a factor of a number is a divisor of that number.* 5 is a factor or divisor of 25 also; and being a factor or divisor of both 30 and 25, it is called a *common factor* or *common divisor* of those numbers. In like manner 9 is a common factor or divisor of 45 and 27.

In the expression $5 \times 8 = 40$, the product, 40, is called a multiple of 5, also of 8; it is a multiple of 4 also; and because it is a multiple of each, it is called a *common multiple* of these numbers.

79. From the foregoing, it is seen, — that *the factors or divisors of a number may be found by inspection, or by trial divisions to find what numbers will divide the given number without a remainder,* — and that *a multiple of a number contains the given number as a divisor without a remainder.*

80. Exercises. —

1. What are the factors of 15? of 25? of 18? of 28?
2. Name three multiples of 3; of 4; of 5; of 7; of 8.
3. Name the divisors of 33; of 42; of 36; of 50; of 39.
4. What are common factors of 15 and 24? 30 and 45?
5. What are common factors of 12, 18 and 30? 15, 45 and 60?
6. Name a common multiple of 3 and 7; of 4 and 6.
7. Name a common multiple of 3, 5 and 6; of 4, 5 and 10.
8. What common divisors have 42 and 56? 36 and 48?
9. 72, 54 and 36 are common multiples of what numbers?

81. A Factor of a number is one of two numbers which, multiplied together, produce the given number. (S. 2.)

Thus 6 is a factor of 30, for 5 times 6 are 30.

82. A Divisor of a number is another number contained in the given number an exact number of times.

Thus, 6 is a divisor of 30, for 6 is contained in 30 five times.

83. A Prime Number is one having no integral factors except itself and one. (S. 11.)

84. A Prime Factor is one which is a prime number.

Thus, 2, 3 and 5 are prime factors of 30; 6, 10 and 15 are factors of 30, but not prime factors.

85. A Multiple of a number is another number of which the given number is a factor.

Thus, 36 is a multiple of 9, for 9 is a factor of 36.

Multiples are called **Composite Numbers.**

86. An Even Number is one ending in 2, 4, 6, 8 or 0.

87. An Odd Number is one ending in 1, 3, 5, 7 or 9.

88. Facts of Divisibility. —

1. An even number is divisible by 2.
2. Any number ending in 5 or 0 is divisible by 5.
3. Any number ending in 0 is divisible by 10.
4. Any number ending in 25, 50, 75 or 00 is divisible by 25.
5. Any number is divisible by 3 when the sum of its digits is divisible by 3.

89. Exercises. —

1. Name the odd numbers below 100; the even numbers.
2. Name the prime factors of 15; of 20; of 36, of 45.
3. Name three multiples of 9; of 12; of 7; of 15.
4. What are the prime factors of 48? What other factors has 48? What factors has 60?
5. Tell at sight some of the divisors of 160; of 75.
6. Of what three numbers is 40 a multiple? 60?
7. Write the prime numbers from 1 to 25; 25 to 50.
8. Write the first ten composite numbers with their prime factors.
9. Find all the divisors of 90; of 125.
10. How many multiples may a number have?

90. The **Prime Factors** of small numbers **are found** by inspection, applying the definitions and Facts.

The prime factors of a large number are found by dividing the number by any prime number greater than *one* that may be a factor of the number, then dividing the quotient in like manner, if it be composite, continuing the process until the quotient is a prime number. The last quotient and the several divisors are the prime factors of the number.

Examples. — 1. What are the prime factors of 285?

ANALYSIS. — The number ends in 5, therefore 5 is one of its prime factors; using this factor as a divisor, the quotient is 57. By inspection, this quotient is seen to be divisible by 3; using this factor as a divisor, the quotient is 19, a prime number. Therefore, the prime factors of 285 are 5, 3 and 19.

OPERATION. —

$285 = 5 \times 3 \times 19$
57
19

2. What are the prime factors of 323?

ANALYSIS. — By inspection (Facts 1, 2 and 5, Art. 88), 2,5 and 3 are not factors of the number. By trial with the successive prime numbers, no factor of the number is found until 17 is reached; using this as a divisor, the quotient is 19 a prime number. Therefore, etc.

3. What are the prime factors of 277?

ANALYSIS. — By inspection and by trial, no prime number smaller than 17, used as a divisor, is found to be a factor of 277; no greater number need be tried, for the quotient would be smaller than 17, and the numbers smaller than 17 are found not to be factors. Therefore, etc.

91. Exercises. — Find the prime factors of —

1. 30
2. 36
3. 39
4. 42
5. 48
6. 56
7. 57
8. 76
9. 60
10. 63
11. 64
12. 68
13. 69
14. 84
15. 87
16. 90
17. 91
18. 96
19. 98
20. 105
21. 108
22. 112
23. 111
24. 119
25. 120
26. 125
27. 144
28. 169
29. 165
30. 289
31. 270
32. 230
33. 576
34. 1001
35. 2560
36. 7840
37. 916
38. 1121
39. 2015
40. 2127

92. A Common Factor or Divisor of two or more numbers is a factor or divisor of each of the numbers.

If the factor or divisor is a prime number, it is called a *Common Prime Factor.* (S. 2.)

Thus, 6 is a common factor of 36 and 48, and 2 and 3 are common *prime* factors of 36 and 48.

93. The Greatest Common Divisor (G. C. D.) of two or more numbers is the greatest factor or divisor of all of the numbers. *It is the product of their common prime factors.*

Thus, the greatest common divisor of 36 and 48 is 12, the product of their common prime factors, 2, 2, and 3.

Examples.—1. What is the G. C. D. of 36 and 54? (S. 12.)

ANALYSIS.—The prime factors of 36 are 2, 2, 3 and 3; of 54, 2, 3, 3 and 3; the *common* prime factors are 2, 3 and 3,—and their product, 18, is the G. C. D. of 36 and 54.

OPERATION.—

$36=2\times2\times3\times3$

$54=2\times3\times3\times3$

$2\times3\times3=18$

NOTE.—In practice, the G. C. D. is commonly found by inspection.

2. What is the G. C. D. of 42, 63 and 126?

ANALYSIS.—By inspection, 3 is a common factor of the numbers, so is 7, and there are no others; the product of 3 and 7 is, therefore, the G. C. D. of 42, 63 and 126. (S. 12.)

3. What is the G. C. D. of 96 and 104?

ANALYSIS.—The difference of the numbers is 8, and this being a divisor of the numbers, it is their G. C. D.

NOTE.—The G. C. D. of two numbers cannot be greater than their difference. (Why?)

94. Exercises.—Find the G. C. D. of—

1. 28, 70.
2. 18, 120.
3. 63, 72.
4. 75, 100.
5. 84, 105.
6. 84, 140.
7. 72, 180.
8. 90, 126.
9. 84, 108.
10. 56, 147.
11. 81, 135.
12. 70, 175.
13. 150, 240.
14. 105, 147.
15. 225, 270.
16. 168, 216.
17. 112, 192.
18. 96, 224.
19. 126, 168.
20. 144, 216.
21. 24, 18, 120.
22. 56, 72, 96.
23. 72, 144, 216.
24. 75, 500, 330.
25. 250, 350, 700.
26. 824, 2712.
27. 1632, 2936.
28. 630, 1008.
29. 2024, 1285.
30. 1110, 1850.

95. A Common Multiple of two or more numbers is another number of which the given numbers are factors.

96. The Least Common Multiple (L. C. M.) of two or more numbers is the least number of which the given numbers are factors. *Its factors are the different prime factors of the numbers, each used as many times as it occurs in any of the numbers.*

Thus, 60 is a common multiple of 4 and 6, and 12 is their *least* common multiple.

Examples. — 1. Find the L. C. M. of 12, 15, and 20.

ANALYSIS. — The prime factors of 12 are two 2's and 3; of 15, 3 and 5; of 20, two 2's and 5. The *different* prime factors are 2, 3 and 5, — 2 occurring twice in '*any*' number, 3 once, and 5 once; their product, 60, is the L. C. M. of the numbers.

OPERATION. —

$12 = 2 \times 2 \times 3$

$15 = 3 \times 5$

$20 = 2 \times 2 \times 5$

$2 \times 2 \times 3 \times 5 = 60.$

2. Find the L. C. M. of 12, 15 and 24.

ANALYSIS. —A multiple of 24 has 24 as a factor, a multiple of 15 also, has 5 also as a factor; a multiple of 24 is a multiple of 12, for 12 is found in 24. The L. C. M. of 12, 15 and 24 is, therefore, the product of 24 and 5, or 120.

NOTE. — The L. C. M. of small numbers is generally found by 'inspection,' as in the last example. (S. 13.)

97. Exercises. — Find the L. C. M. of —

1. 8, 12, 20.
2. 3, 4, 5, 8.
3. 3, 6, 8, 10.
4. 4, 5, 6, 9.
5. 3, 4, 6, 7.
6. 5, 8, 10, 12.
7. 2, 3, 7, 8.
8. 5, 15, 20.
9. 4, 5, 7, 8.
10. 6, 8, 9, 12.
11. 4, 6, 9, 18.
12. 4, 5, 8, 16.
13. 4, 5, 12, 20.
14. 7, 9, 21, 3.
15. 9, 7, 27, 3.
16. 3, 4, 16, 8.
17. 6, 12, 8, 18.
18. 9, 6, 5, 15.
19. 2, 4, 11, 22.
20. 6, 9, 12, 24.
21. 15, 10, 11, 22.
22. 8, 12, 15, 20.
23. 7, 15, 21, 25.
24. 13, 14, 2, 7.
25. 6, 9, 10, 15.
26. 15, 10, 24, 25.
27. 4, 9, 11, 18.
28. 3, 4, 21, 28.
29. 5, 7, 15, 21.
30. 27, 24, 15.
31. 19, 27, 36.
32. 13, 17, 19, 8.
33. 35, 63, 72.
34. 12, 51, 68.
35. 15, 24, 60.
36. 9, 12, 14, 70.
37. 23, 27, 54.
38. $18, $12, $75.
39. 54, 22, 24.

98. 1. What is the L. C. M. of 15 and 30? their G. C. D.?

2. Gave 14 cords of wood for 5 tons of hay at $17.50 per ton; what was the price of the wood per cord?

3. What is the length of the shortest piece of rope that may be cut in pieces 4, 6 or 10 feet long?

4. Divide $98.50 between John and James so as to give John $7.40 more than James.

5. How much more than $208.20 will 29 barrels of flour cost, at $8.45 per barrel?

6. Add $13.80, $9.87, $8.74, $17.59, $6.98 and $9.76.

7. From 73680 take 68594. 8. Multiply 93.58 by 78.

9. Find $\frac{1}{59}$ of 70940. 10. Divide $658 by $2.35.

99. 1. 12 bbl. of flour cost $108; what will 18 bbl. cost?

2. 3 books cost $4.35; what will 30 books cost?

3. What is the smallest sum that may be paid with either 5, 10, 20 or 25-cent pieces?

4. Find the average price of 22 acres of land at $37.50 per acre and 38 at $27.50 per acre.

5. What cost 76 lb. of beef at $.11 a pound, 48 lb. of bacon at $.16 a pound, and 68 lb. of pork at $.125 a pound?

6. How many days are there in 4.5 years?

7. What cost 8.5 tons of hay at $13.25 a ton?

8. Find the L. C. M of 9, 45, 60, 72, 15, 18 and 12.

9. Find the G. C. D. of 450 and 792.

10. How many feet in 176 rods?

100. 1. What is the L. C. M. of 12, 16 and 18?

2. How many books, at $.22 each, cost $4.62?

3. I have $1.40; how many melons, at $.15 each, can I buy?

4. The ages of three boys are 9, 11 and 17 years; what is the average of their ages?

5. 105 sheep were sold for $668.85; find the price per head.

6. The President's salary is $50000 a year; how much per month? per day?

7. A shoemaker received $172.50 for shoes at $3.25 per pair; how many pairs did he sell?

8. Find the G. C. D. of 775 and 2015.

VII. ANALYSIS.

101. Analysis, in Arithmetic, is the process of solving examples or problems by tracing the relations of numbers.

Examples. — 1. When 7 books cost $21, what will 9 cost?

ANALYSIS. —When 7 books cost $21, one book costs *one seventh* of $21 or $3; and 9 books cost 9 times $3, or $27.

2. 7 plows cost $63; how many will $45 buy?

ANALYSIS. —If 7 plows cost $63, one plow costs *one seventh* of $63, or $9; and $45 will buy as many as $9 are contained times in $45, or 5 plows.

Operations in Analysis may be shortened by **Cancellation.**

In ex. 1, it is seen that $\frac{1}{7}$ of $21 is multiplied by 9; that is, the same as $\frac{1}{7}$ of $21×9 is found. This may be indicated as in the Operation, in which $21 and 9 are the factors of a dividend, and 7 the divisor; then, cancelling the common factor, 7, in both dividend and divisor (Art. 60), the result, $27, is found.

OPERATION. —

$$\frac{\$\overset{3}{\cancel{21}}\times 9}{\cancel{7}}=\$27.$$

In ex. 2, $1 pays for $\frac{1}{63}$ of 7 plows; and $45 buy 45 times as many; or 5 plows, canceling 7 from both dividend and divisor, as in the margin.

OPERATION. —

$$\frac{\cancel{7}\times 45}{\underset{9}{\cancel{63}}}=5.$$

3. 5 men earn $90 in 6 days; what do 6 men earn in 9 days?

ANALYSIS. —If 5 men in 6 days earn $90, the amount earned by *one man* in *one day* may be indicated as in *a;* and the amount earned by 6 men in 9 days as in *b*, in which $90, 6 and 9 appear as factors of a dividend, and 5 and 6 as factors of a divisor. Canceling the common factors, 5 and 6, the result, $162, is found.

OPERATION. —

a. $\frac{\$90}{5\times 6}=?$

b. $\frac{\$\overset{18}{\cancel{90}}\times\cancel{6}\times 9}{\cancel{5}\times\cancel{6}}=\$162.$

When the work is arranged as above, the operation is called **Straight-Line Analysis.** *The first number written above the line is like the answer.* (S. 14.)

102. Exercises. — (S. 3.)

1. A man earns $2.50 a day, and pays 75 cents a day for his board; how much may he save in 10 days?

2. If 8 horses cost $1200, what will 12 cost at that rate?

3. What will 15 books cost, at the rate of 9 for $10.80?

4. If 36 rods of fence cost $126, what will 60 rods cost?

5. 100 gallons of oil cost $12.50; what cost 80 gallons?

6. 234 tons of coal cost $1404; how many cost $1275?

7. Multiply 9307 by 795. 8. Divide 17634 by 509.

9. From 10706 take 8397. 10. Find $\frac{1}{67}$ of 5839.

103. 1. How many tons of coal, at $9 a ton, are worth as much as 27 cords of wood, at $6 a cord?

2. If half an acre of land is worth $35, how much are 15 acres worth at the same rate?

3. If a yard and a half of cloth cost $4.50, how much are 12 yards worth at the same rate?

4. If 12 gal. of sirup cost $5.40, what cost 26 gal.?

5. If 8 oz. of pepper cost 10 cents, what cost 3 lb.?

6. If 12 gal. of oil cost $7.20, how many gallons cost $13.80?

7. 9 hats cost $22.50; 7 dozen cost how much at that rate?

8. Multiply $76.58 by 38. 9. Divide $54.50 by $.75.

10. What cost 9 lb. 8 oz. of lard at $.14 a pound?

104. 1. 8 books cost $20; what cost 5 at that rate?

2. 8 men build a wall in 9 days; how long should it take 12 men to build it?

3. If 6 men build a barn in 15 days, how many men should be able to build it in ten days?

4. If a 4-cent loaf of bread weigh 12 ounces, how much should a 6-cent loaf weigh?

5. 3 yd. of cloth cost $1½; what cost 19 yd.?

6. If 9 bu. of oats feed 4 horses 3 days, how long would 30 bushels last them?

7. If 3 men dig a ditch in 10 days working 10 hours a day, how long should it take 6 men working 8 hours a day?

8. If 8 yd. of cloth cost $5, how much will 20 yd. cost?

9. Multiply 9756 by 2087. 10. Divide 43072 by 891.

105. 1. If 11 men earn $165 in a week, how much will 9 men earn in the same time?

2. If $7.60 be divided equally among 8 boys, how much will 5 of them receive?

3. If a train runs 468 miles in 12 hours, in how many hours will it run 333 miles?

4. What is the amount of a laundry bill of 20 pieces, washed at $.75 a dozen?

5. What cost 18 quarts of milk at 30 cents a gallon?

6. What cost 8 photographs at $4.50 a dozen?

7. Multiply $17.93 by 79. 8. Divide $26.55 by $.45.

9. From $57 take $29.37. 10. Divide 10376 by 684.

106. 1. A clerk earns $45 a month and his expenses are $30 a month; how long will it take him to save $225?

2. How many barrels of flour, 196 pounds each, will 176 bushels of wheat make, if each bushel makes 43 lb. of flour?

3. How many square yards of matting will cover a floor 18 feet long and 15 feet wide?

4. What cost 35 tons of hay, when 47 tons cost $258.50?

5. In how many days should 30 men do as much work as 12 men do in 25 days?

6. A has $165 more than B; both have $547; how much has each?

7. 15 times $78 are how many times $26?

8. Multiply $83.75 by 48. 9. From $101 take $86.54.

107. 1. 160 square rods make an acre; how many acres in a field 96 rods long and 70 rods wide?

2. The product of three numbers is 44800, one of the numbers is 56, another is 25; find the third number.

3. The dividend is $257.20, the quotient is 73, and the remainder is $1.70; find the divisor.

4. The quotient is $1.65, the divisor 83; find the dividend.

5. How many barrels of flour in 7360 pounds?

6. How many square yards in an area 35 ft. by 24 ft.?

7. Multiply $7.63 by 59. 8. Divide 83756 by 3040.

9. Add 79, 53, 87, 246, 845, 597, 88 and 595.

108. 1. 24 men construct a bridge in 45 days; how many days should it take 36 men?

2. 8 men earn $175 in 5 days, how much does each man earn each day?

3. 13 pieces of cloth, 35 yd. each, will make how many suits of clothes, each requiring 7 yd.?

4. When 12 yd. of cloth cost $18, what do 28 yd. cost?

5. If 3 hats cost $8, what will 3 dozen cost?

6. If 5 tons of iron cost $80.50, what will 12 tons cost?

7. What cost 4 hats, when 3 dozen cost $68.70?

8. $42 buy 28 books; how many cost $51?

9. 144×75,÷9,×35=? 10. $91×25,÷$65=?

109. 1. 45 yd. of velvet cost $165; what cost 23 yd.?

2. 35 tons of coal cost $140; 77 tons cost how much?

3. I traded 120 head of cattle at $64 a head, for 160 acres of land; what was the land worth per acre?

4. How many mules at $85 each, are worth as much as 34 horses at $125 each?

5. 18 dozen brooms cost $45; how many dozen cost $60?

6. In how many days should 48 men earn as much as 40 men earn in 9 days?

7. If 15 books cost $3, $22 will pay for how many?

8. Add 297, 3858, 7984, 9717, 8056, 943, 829, 7782, 39876, 948, 7463 and 55188.

9. Multiply 5940 by 793. 10. Divide 83765 by 908.

110. 1. How far can a man travel in 16 days, at the rate of 672 in 7 days?

2. How many lb. of coffee cost $21, when 30 lb. cost $6?

3. 148 acres of land cost $1887, how many acres of the same are worth $255?

4. 8 men live 15 days for $136; how long may they live for $216?

5. If 8 persons board 15 days for $144, what will it cost 6 persons for 24 days?

6. 128÷9,×12=? 7. 90×24,÷75=?

8. 20×16,÷24=? 9. 12×18,÷16=?

FRACTIONS.

I. NOTATION AND REDUCTIONS.

111. When any unit, as an apple, is separated into *two* equal parts, each of these equal parts is called *one half;* if the unit is separated into *three* equal parts, each part is called *one third*, and two of them are called *two thirds*. These parts of a whole are called **Fractions.**

If you separate an orange into *four* equal parts, and give me *three* of them, what part of the whole will I have? If you separate the orange into *eight* equal parts, and give me three of them what part of the whole will I have? what part of the whole will you have left?

Show me *one sixth* of a sheet of paper; *five sixths; two sixths. Two sixths* of the sheet of paper are what part of the whole sheet? *three sixths* equal what other part of the whole? *four sixths?*

If you separate a sheet of paper into *five* equal parts, what is each part called? *four* of them? If each of these parts be separated into *two* equal parts, how many parts will there now be in the whole? *Two* of these parts will make what? show with the pieces of paper. Show what *four* of them make; *five* of them.

What part of the value of a dollar is a *quarter* or twenty-five cent piece? If you have *three* quarters, what part of a dollar have you? if you have *five* quarters? if you have *six* quarters? *eight* quarters? *nine? fifteen?*

NOTE.—The teacher should illustrate these facts, and the following definitions and operations, with objects, and should have pupils do the same,—every operation of practical value may be so illustrated. Pupils should not be called upon to do or 'recite' what they are unable to show in concrete form.

112. A Fraction is one or more of the equal parts of a unit; as, *one half*, *two thirds*, $\frac{3}{5}$, \$$\frac{5}{8}$.

Three fifths is a fraction, because it is made up of *three* of the five equal parts of a unit.

Every unit equals *two halves*, 3 *thirds*, $\frac{4}{4}$, $\frac{5}{5}$, $\frac{10}{10}$, etc.

Each of the equal parts into which a unit is separated is a **Fractional Unit**; thus, in the fraction *five sixths*, the fractional unit is *one sixth*.

113. The Denominator of a fraction is the number showing into how many equal parts the unit is separated.

114. The Numerator of a fraction is the number showing how many equal parts are taken in the fraction.

The numerator and denominator together are the **Terms** of the fraction. Thus, in the fraction *five sixths*, *six* is the denominator and *five* the numerator, and the fraction is written in figures, '$\frac{5}{6}$.'

115. A Proper Fraction is one whose numerator is less in value than its denominator; as, $\frac{3}{4}$, $\frac{5}{7}$.

116. An Improper Fraction is one whose numerator is equal to, or greater than, its denominator; as, $\frac{4}{4}$, $\frac{7}{5}$.

The value of a proper fraction is less than *one;* the value of an improper fraction is equal to, or greater, than *one*.

117. A Mixed Number is a whole number and a fraction united; as, $3\frac{1}{2}$, $7\frac{2}{3}$, $9\frac{5}{8}$.

118. Similar Fractions are such as have the same fractional unit, or a common denominator; as, $\frac{3}{8}$, $\frac{5}{8}$ and $\frac{11}{8}$.

119. Equivalent Fractions are equal in value; as, $\frac{3}{4}$ and $\frac{6}{8}$.

120. Principles. — A fraction may be considered an example in Division (Separation), in which the numerator is the number separated into equal parts, and the denominator is the number of equal parts. Then —

I. If both terms of a fraction be multiplied by the same number, the fraction is not changed in value. (S. 15.)

II. If both terms of a fraction be divided by the same number, the fraction is not changed in value.

121. Improper Fractions *may be changed or reduced to whole or mixed numbers.* Thus, the fraction $\frac{10}{3}$: "There are 3 *thirds* in *one*, and in 10 *thirds* as many *ones* as 3 *thirds* are contained times in 10 *thirds*, or $3\frac{1}{3}$ ones." (S. 16.)

122. Exercises. — Change to whole or mixed numbers —

1. $\frac{7}{2}$
2. $\frac{13}{3}$
3. $\frac{21}{5}$
4. $\frac{28}{3}$
5. $\frac{29}{5}$
6. $\frac{19}{4}$
7. $\frac{23}{5}$
8. $\frac{21}{9}$
9. $\frac{15}{8}$
10. $\frac{20}{7}$
11. $\frac{42}{6}$
12. $\frac{31}{9}$
13. $\frac{47}{12}$
14. $\frac{75}{5}$
15. $\frac{51}{3}$
16. $\frac{36}{8}$
17. $\frac{76}{9}$
18. $\frac{100}{9}$
19. $\frac{108}{6}$
20. $\frac{120}{10}$
21. $\frac{154}{7}$
22. $\frac{115}{11}$
23. $\frac{200}{12}$
24. $\frac{325}{9}$
25. $\frac{225}{15}$
26. $\$\frac{516}{24}$
27. $\frac{319}{17}$
28. $\frac{561}{37}$
29. $\frac{297}{43}$
30. $\frac{1055}{221}$

123. Whole or Mixed Numbers *may be changed to improper fractions.* Thus, $5\frac{3}{4}$: "In *one* there are 4 *fourths*, and in $5\frac{3}{4}$ there are 5 times 4 *fourths*, plus 3 *fourths*, or $\frac{23}{4}$." (S. 16.)

124. Exercises. — Reduce to improper fractions —

1. $3\frac{1}{3}$
2. $2\frac{3}{4}$
3. $5\frac{1}{4}$
4. $7\frac{5}{6}$
5. $3\frac{5}{7}$
6. $\$9\frac{3}{5}$
7. $5\frac{7}{8}$ bu.
8. $8\frac{5}{9}$ ft.
9. $7\frac{5}{6}$ yd.
10. $5\frac{5}{8}$ lb.
11. $16\frac{2}{3}$
12. $20\frac{1}{4}$
13. $3\frac{4}{15}$
14. $12\frac{5}{7}$
15. $10\frac{7}{10}$
16. $21\frac{2}{3}$
17. $95\frac{4}{5}$
18. $2\frac{9}{42}$
19. $19\frac{11}{12}$
20. $22\frac{4}{5}$
21. $73\frac{5}{6}$
22. $9\frac{13}{30}$
23. $7\frac{9}{25}$
24. $7\frac{11}{23}$
25. $18\frac{15}{16}$
26. $97\frac{5}{11}$
27. $28\frac{3}{28}$
28. $7\frac{5}{39}$
29. $6\frac{17}{220}$
30. $5\frac{111}{430}$

125. *Fractions may be changed to equivalent fractions having* **lower terms.** A fraction is in its **Lowest Terms** when its value is expressed in the smallest possible numbers. Thus, $\frac{2}{4}$ of a dollar are expressed in lowest terms as $\frac{1}{2}$ of a dollar, $\frac{4}{12}$ of a foot as $\frac{1}{3}$ of a foot, $\frac{8}{16}$, $\frac{7}{14}$, $\frac{6}{12}$, etc. as $\frac{1}{2}$.

When a fraction is in its lowest terms, no whole number greater than *one* is a factor of both terms, — that is, the terms are prime to each other.

Fractions are reduced to lowest terms for convenience, applying Prin. II. Art. 120, or Prin. IV., Art. 60.

126. Exercises. — Reduce to lowest terms —

1. $\frac{8}{16}$
2. $\frac{10}{12}$
3. $\frac{12}{18}$
4. $\frac{16}{20}$
5. $\frac{20}{25}$
6. $\frac{24}{32}$
7. $\frac{14}{35}$
8. $\frac{42}{63}$
9. $\frac{42}{56}$
10. $\frac{75}{80}$
11. $\frac{63}{81}$
12. $\frac{54}{72}$
13. $\frac{57}{84}$
14. $\frac{65}{91}$
15. $\frac{63}{90}$
16. $\frac{90}{120}$
17. $\frac{84}{108}$
18. $\frac{28}{110}$
19. $\frac{60}{180}$
20. $\frac{21}{105}$
21. $\frac{125}{125}$
22. $\frac{91}{147}$
23. $\frac{72}{124}$
24. $\frac{56}{168}$
25. $\frac{45}{108}$
26. $\frac{325}{720}$
27. $\frac{625}{900}$
28. $\frac{297}{528}$
29. $\frac{85}{153}$
30. $\frac{272}{428}$

127. *Fractions may be reduced to equivalent fractions having* **higher terms.** Thus, $\frac{1}{2}$ may be changed to $\frac{2}{4}$, $\frac{3}{6}$, $\frac{4}{8}$, etc.; and $\frac{1}{2}$, $\frac{2}{3}$ and $\frac{3}{4}$ may be changed to *twelfths*, as $\frac{6}{12}$, $\frac{8}{12}$ and $\frac{9}{12}$. See Prin. I., Art. 120, and Prin. III., Art. 60.

128. Exercises. — Reduce —

1. $\frac{1}{3}$ to 18ths.
2. $\frac{3}{4}$ to 24ths.
3. $\frac{2}{5}$ to 30ths.
4. $\frac{5}{6}$ to 36ths.
5. $\frac{3}{8}$ to 56ths.
6. $\frac{5}{9}$ to 45ths.
7. $\frac{7}{8}$ to 24ths.
8. $\frac{5}{7}$ to 35ths.
9. $\frac{7}{11}$ to 33rds.
10. $\frac{7}{12}$ to 84ths.
11. $\frac{5}{12}$ to 108ths.
12. $\frac{7}{15}$ to 60ths.
13. $\frac{17}{20}$ to 60ths.
14. $\frac{11}{15}$ to 90ths.
15. $\frac{11}{125}$ to 625ths.
16. $\frac{9}{16}$ to 128ths.
17. $\frac{17}{18}$ to 144ths.
18. $\frac{7}{9}$ to 225ths.

129. *Fractions may be reduced to* **Similar Fractions.** They are then said to have a *common denominator.* Thus, $\frac{1}{3}$, $\frac{3}{5}$ and $\frac{7}{15}$ may be changed to the *similar fractions* $\frac{5}{15}$, $\frac{9}{15}$ and $\frac{7}{15}$, having the *common denominator*, 15.

The common denominator is some number which will exactly contain the given denominators (see Art. 96), and may usually be found by inspection; it may be the largest of the given denominators, — it can not be a smaller number.

Examples. —1. Change $\frac{3}{4}$, $\frac{2}{3}$ and $\frac{7}{12}$ to similar fractions.

ANALYSIS. — The largest denominator, 12, contains the others without a remainder, and the fractions $\frac{3}{4}$ and $\frac{2}{3}$ may be changed to *twelfths*, and the similar fractions are found to be, $\frac{9}{12}$, $\frac{8}{12}$ and $\frac{7}{12}$. 24, 36 or 48 *might* be taken for the common denominator, but 12 is more convenient. (Why?)

NOTE. — Always take for the common denominator the smallest number possible, that is, the L. C. M. of the given denominators. See Art. 93.

2. Reduce $\frac{2}{3}$, $\frac{3}{4}$ and $\frac{4}{5}$ to a common denominator.

ANALYSIS. — The smallest number which contains 3 and 4 is 12, and that contains 5 also, is 5 times 12, or 60; and the similar fractions are found to be $\frac{40}{60}$, $\frac{45}{60}$ and $\frac{48}{60}$.

130. Exercises. — Change to similar fractions —

1. $\frac{1}{3}$, $\frac{3}{4}$, $\frac{3}{5}$.
2. $\frac{2}{3}$, $\frac{5}{6}$, $\frac{11}{12}$.
3. $\frac{4}{5}$, $\frac{5}{6}$, $\frac{7}{10}$.
4. $\frac{3}{4}$, $\frac{5}{6}$, $\frac{5}{8}$.
5. $\frac{2}{3}$, $\frac{7}{9}$, $\frac{2}{5}$.
6. $\frac{1}{2}$, $\frac{4}{7}$, $\frac{7}{8}$.
7. $\frac{1}{2}$, $\frac{3}{7}$, $\frac{5}{6}$.
8. $\frac{7}{8}$, $\frac{5}{6}$, $\frac{7}{12}$.
9. $\frac{5}{6}$, $\frac{4}{9}$, $\frac{11}{12}$.
10. $\frac{7}{9}$, $\frac{2}{3}$, $\frac{4}{7}$.
11. $\frac{5}{8}$, $\frac{3}{5}$, $\frac{7}{16}$, $\frac{3}{4}$.
12. $\frac{5}{8}$, $\frac{7}{9}$, $\frac{11}{12}$, $\frac{7}{18}$.
13. $\frac{5}{6}$, $\frac{3}{4}$, $\frac{7}{12}$, $\frac{13}{20}$.
14. $4\frac{2}{3}$, $7\frac{5}{8}$, $2\frac{5}{6}$.
15. $5\frac{3}{7}$, $2\frac{1}{4}$, $8\frac{3}{5}$.

II. ADDITION.

131. In Integers, similar numbers only may be added; so, in Fractions, *similar fractions only may be added.*

Examples. — 1. What is the sum of $\frac{1}{5}$, $\frac{3}{5}$ and $\frac{4}{5}$?

Analysis. — These fractions are similar — that is, they have the same fractional unit, — and their sum is the number of parts expressed by the sum of their numerators. 1 *fifth*+3 *fifths*+4 *fifths*=8 *fifths*, or $1\frac{3}{5}$.

2. Add $2\frac{1}{2}$, $1\frac{2}{3}$ and $2\frac{3}{4}$. (S. 16.)

Analysis. — In their given forms these fractions can not be added. In order that they may be added, they must be changed to similar fractions (Art. 129); they may be changed to *twelfths;* $2\frac{1}{2}=2\frac{6}{12}$, $1\frac{2}{3}=1\frac{8}{12}$, and $2\frac{3}{4}=2\frac{9}{12}$; $2\frac{6}{12}+1\frac{8}{12}+2\frac{9}{12}=5\frac{23}{12}$, or $6\frac{11}{12}$.

Operation. —

$$\begin{array}{r} 2\frac{1}{2}=2\frac{6}{12} \\ 1\frac{2}{3}=1\frac{8}{12} \\ 2\frac{3}{4}=2\frac{9}{12} \\ \hline 5\frac{23}{12}=6\frac{11}{12}. \end{array}$$

Note. — It is not necessary to change whole or mixed numbers to improper fractions for addition.

132. Exercises. — *Oral and Written.* —

1. A lady used $8\frac{1}{2}$ yd. of cloth for a dress, and $3\frac{3}{4}$ yd. for a cloak; how much for both?

2. A boy paid $\$\frac{3}{4}$ for a knife, and $\$1\frac{4}{5}$ for a pair of skates; how much for both?

3. $\frac{1}{4}+\frac{3}{4}+2\frac{1}{4}$ 5. $1\frac{1}{2}$ yd.$+2\frac{3}{4}$ yd. 7. $\frac{1}{2}+\frac{1}{18}+\frac{2}{9}$

4. $\frac{2}{7}+\frac{3}{7}+3\frac{5}{7}$ 6. $\$5\frac{3}{4}+\$3\frac{2}{5}$ 8. $\frac{1}{4}+\frac{3}{8}+\frac{1}{6}$

9. Add 739, 8798, 597, 809, 5398, 896 and 979.

10. Multiply \$9.65 by 120. 11. Divide 19378 by 675.

133. 1. A tinner worked $4\frac{3}{4}$ days for one man, and $2\frac{2}{3}$ days for another; how much for both?

2. A man paid $\$12\frac{4}{5}$ for a coat and $\$3\frac{3}{4}$ for a hat; how much did he pay for both?

3. What is the square of 15? the cube of 12? (Art. 46.)

4. $\frac{1}{2}+\frac{2}{3}+\frac{5}{6}$ 6. $\frac{2}{3}$ ft.$+\frac{3}{4}$ ft.$+\frac{5}{6}$ ft. 8. $2\frac{1}{2}+3\frac{5}{8}+4\frac{7}{12}$

5. $\frac{1}{2}+\frac{1}{8}+\frac{5}{12}$ 7. $\frac{1}{2}$ lb.$+\frac{5}{8}$ lb.$+\frac{7}{16}$ lb. 9. $3\frac{5}{6}+2\frac{5}{9}+5\frac{3}{4}$

10. Divide \$37.50 by \$.125. 11. Multiply 9807 by 796.

134. 1. A dealer sold $5\frac{3}{4}$ tons of coal to one man, and $3\frac{3}{8}$ tons to another; how much to both?

2. A boy paid $\$\frac{3}{5}$ for a book, $\$\frac{3}{4}$ for a knife, and had $\$1\frac{7}{10}$ left; how much had he at first?

3. $\frac{3}{8}+\frac{5}{6}+\frac{7}{12}$
4. $\frac{5}{6}+\frac{6}{5}+\frac{7}{15}$
5. $\frac{3}{4}+\frac{5}{9}+\frac{7}{12}$
6. $\frac{5}{8}+\frac{5}{16}+\frac{7}{24}$
7. $\frac{4}{7}+\frac{3}{4}+\frac{9}{14}+\frac{1}{2}$
8. $\frac{3}{5}+\frac{3}{4}+\frac{7}{10}+\frac{1}{2}$
9. $\frac{5}{6}+\frac{3}{5}+\frac{5}{12}+\frac{3}{4}$
10. $\frac{2}{3}+\frac{5}{9}+\frac{7}{15}+\frac{4}{5}$
11. $7\frac{1}{2}+2\frac{4}{5}+3\frac{3}{4}$
12. $9\frac{1}{3}+5\frac{1}{6}+2\frac{4}{5}$
13. $2\frac{3}{4}+2\frac{2}{3}+8\frac{5}{8}$
14. $1\frac{7}{12}+7\frac{3}{10}+3\frac{2}{15}$

135. 1. If a load of wood cost $\$4\frac{1}{5}$, a barrel of flour $\$7\frac{3}{4}$, and a box of sugar $\$5\frac{1}{2}$; how much do all cost?

2. In one field there are $18\frac{5}{16}$ acres, in another $12\frac{7}{8}$ acres, in a third $15\frac{3}{4}$ acres; how many acres in all?

3. $5\frac{2}{5}+7\frac{3}{8}+19\frac{3}{4}$
4. $9\frac{2}{3}+1\frac{5}{7}+7\frac{3}{4}$
5. $1\frac{5}{11}+3\frac{3}{4}+3\frac{1}{2}$
6. $4\frac{2}{5}+3\frac{7}{12}+3\frac{9}{10}$
7. $7\frac{1}{4}+5\frac{7}{10}+22$
8. $15\frac{1}{2}+17+8\frac{4}{15}$
9. $2\frac{3}{5}+15\frac{3}{4}+7\frac{5}{6}$
10. $13\frac{7}{8}+2\frac{7}{9}+4\frac{5}{12}$
11. $28\frac{4}{15}+13\frac{5}{6}+15\frac{7}{10}$
12. $7\frac{3}{4}+9\frac{7}{12}+11\frac{5}{8}$
13. $3\frac{3}{5}+7\frac{14}{15}+9\frac{5}{12}$
14. $24\frac{2}{9}+14\frac{5}{6}+7\frac{2}{3}$

136. 1. John has $\$17\frac{3}{5}$, Tom $\$15\frac{3}{4}$ more than John; how much has he?

2. From a tank of oil $25\frac{7}{16}$ gallons leaked out, and $89\frac{5}{8}$ gallons remained; how much was there at first?

3. $\frac{1}{4}+\frac{1}{7}+\frac{3}{8}+\frac{3}{14}$
4. $\frac{2}{5}+\frac{1}{6}+\frac{3}{4}+\frac{7}{12}$
5. $\frac{2}{7}+\frac{5}{12}+\frac{2}{21}+\frac{5}{6}$
6. $\frac{3}{4}+\frac{2}{5}+\frac{7}{10}+\frac{7}{12}$
7. $9\frac{3}{5}+7\frac{5}{6}+12\frac{2}{3}$
8. $3\frac{5}{9}+7\frac{3}{4}+15\frac{5}{6}$
9. $47\frac{3}{8}+9\frac{5}{6}+7\frac{11}{24}$
10. $18\frac{7}{8}+44\frac{5}{9}+3\frac{7}{12}$
11. $253\frac{1}{2}+708\frac{5}{6}$
12. $327\frac{4}{15}+235\frac{7}{12}$
13. $2074\frac{5}{8}+193\frac{17}{20}$
14. $427\frac{5}{9}+219\frac{11}{15}$

137. 1. What number multiplied by 87 gives 4176?

2. From a farm of 137.5 acres, 32.875 acres were sold; how much remained in the farm?

3. How much will a telegraph line 286 miles long cost, at $1256 per mile?

4. Smith paid $50 for a harness, which was $76 less than he paid for his horse; how much did both cost?

5. What cost 17 bbl. of sugar, 268 lb. each, at $.09 per lb.?

6. 36 mules cost $2780, and 27 others cost $3268; what was the average price for both lots?

7. Add $27\frac{5}{14}$, $9\frac{3}{8}$ and $8\frac{6}{7}$.
8. Multiply $19.75 by 56.

9. Add $9\frac{5}{12}$, $23\frac{7}{8}$ and $44\frac{7}{15}$
10. Divide $575 by $.75.

III. SUBTRACTION.

138. In Integers, a number may be taken from a similar number only; so, in Fractions, *a fraction may be taken from a similar fraction only.*

Examples. — 1. Find the difference between $\frac{5}{8}$ and $\frac{3}{8}$. (S. 16.)

ANALYSIS. — These fractions are similar,— that is, they have the same fractional unit, — and their difference is as many of these parts as are expressed by the difference of their numerators. 5 *eighths* less 3 *eighths*=2 eighths, or $\frac{1}{4}$.

2. From $\frac{2}{3}$ take $\frac{5}{8}$.

ANALYSIS. — In their given forms, $\frac{5}{8}$ can not be taken from $\frac{2}{3}$; they must be changed to similar fractions (Art. 129); they may be changed to *twenty-fourths;* $\frac{2}{3}=\frac{16}{24}$, and $\frac{5}{8}=\frac{15}{24}$; then $\frac{16}{24}-\frac{15}{24}=\frac{1}{24}$.

OPERATION. —

$$\begin{array}{l} \frac{2}{3}=\frac{16}{24} \\ \frac{5}{8}=\frac{15}{24} \\ \hline \quad\ \frac{1}{24} \end{array}$$

3. From $3\frac{2}{5}$ take $1\frac{3}{4}$.

ANALYSIS. —A common denominator is found in 20; $3\frac{2}{5}=3\frac{8}{20}$, and $1\frac{3}{4}=1\frac{15}{20}$; but $\frac{15}{20}$ are more than $\frac{8}{20}$; *one* taken from *three* and added (as $\frac{20}{20}$) to $\frac{8}{20}$ gives $\frac{28}{20}$; and $2\frac{28}{20}-1\frac{15}{20}=1\frac{13}{20}$.

OPERATION. —

$$\begin{array}{lr} 3\frac{2}{5}=3\frac{8}{20}= & 2\frac{28}{20} \\ 1\frac{3}{4}= & 1\frac{15}{20} \\ \hline & 1\frac{13}{20} \end{array}$$

139. Exercises. — *Oral and Written.* —

1. A boy having $\frac{3}{4}$ of a dollar, spent $\frac{1}{2}$ of a dollar; how much had he left?

2. A girl bought 4 yards of ribbon; after using $\frac{3}{4}$ of a yard, how much had she then?

3. A tailor having a piece of cloth containing $7\frac{1}{4}$ yards, used $3\frac{3}{4}$ yards of it; how much was left?

4. $2\frac{5}{8}$ acres of land were sold from a lot containing $7\frac{1}{2}$ acres; how much remained in the lot?

5. $\frac{5}{8}-\frac{3}{8}$
6. $\frac{5}{6}-\frac{1}{3}$
7. $\frac{1}{2}-\frac{1}{3}$
8. $\frac{11}{12}-\frac{2}{3}$
9. $\frac{3}{4}-\frac{2}{5}$
10. $\frac{5}{6}-\frac{3}{4}$
11. $\frac{4}{5}-\frac{3}{4}$
12. $\frac{4}{5}-\frac{2}{3}$
13. $\frac{6}{7}-\frac{1}{2}$
14. $\frac{7}{9}-\frac{1}{2}$
15. $\frac{7}{8}-\frac{5}{6}$
16. $\frac{3}{5}-\frac{1}{6}$

140. 1. John gathered $3\frac{1}{2}$ bushels of chestnuts, and sold $2\frac{5}{8}$ bushels; how many had he left?

2. Mary and Sue had $3\frac{1}{4}$ lb. of candy; if Mary took $2\frac{3}{8}$ lb., how much was left for Sue?

3. $7\frac{2}{9}$ yards are how much more than $3\frac{3}{4}$ yards?

4. $\$\frac{5}{6}-\$\frac{7}{10}$
5. $\frac{3}{5}$ wk.$-\frac{2}{7}$ wk.
6. $\frac{5}{9}$ ft.$-\frac{1}{4}$ ft.
7. $\frac{11}{18}-\frac{5}{12}$
8. $\frac{2}{3}-\frac{3}{20}$
9. $\frac{5}{8}-\frac{4}{9}$
10. $\frac{4}{15}-\frac{2}{9}$
11. $\frac{15}{16}-\frac{5}{6}$
12. $\frac{13}{21}-\frac{5}{14}$
13. $7\frac{1}{3}-2\frac{2}{7}$
14. $4\frac{4}{9}-2\frac{5}{12}$
15. $8\frac{3}{5}-4\frac{5}{9}$

141. 1. When a ton of hay costs $\$7\frac{7}{8}$, and is sold for $\$9\frac{3}{5}$, how much is gained?

2. A man who owned $\frac{5}{8}$ of a mill, sold $\frac{1}{3}$ of it; what part of the mill did he still own?

3. From a cask containing $37\frac{1}{2}$ gallons of sirup, $15\frac{3}{8}$ gallons were drawn; how much remained in the cask?

4. $\frac{5}{8}-\frac{2}{9}$
5. $\frac{11}{18}-\frac{5}{12}$
6. $\frac{15}{16}-\frac{3}{5}$
7. $\frac{13}{15}-\frac{9}{20}$
8. $\frac{2}{3}-\frac{5}{17}$
9. $\frac{5}{6}-\frac{7}{11}$
10. $\frac{5}{7}-\frac{7}{15}$
11. $\frac{7}{9}-\frac{4}{7}$
12. $\frac{23}{24}-\frac{13}{16}$
13. $5\frac{3}{5}-2\frac{2}{3}$
14. $7\frac{1}{2}-3\frac{2}{9}$
15. $8\frac{3}{4}-5\frac{4}{5}$

142. 1. A merchant sold cloth at $\$3\frac{1}{4}$ per yard, gaining $\$1\frac{1}{2}$ per yard; find the cost.

2. Sam has $\$3\frac{7}{10}$; how much does he lack of having enough to buy a dozen chickens worth $\$4\frac{2}{5}$?

3. A lady bought 11 yards of silk; after using $3\frac{3}{8}$ yards, how much had she left?

4. $7\frac{3}{5}-4\frac{1}{6}$
5. $9\frac{7}{9}-2\frac{2}{3}$
6. $3\frac{7}{9}-2\frac{3}{4}$
7. $8\frac{3}{8}-5\frac{4}{7}$
8. $9\frac{5}{6}-2\frac{3}{7}$
9. $6\frac{2}{3}-2\frac{7}{10}$
10. $8\frac{5}{9}-3\frac{5}{12}$
11. $9\frac{2}{3}-5\frac{11}{16}$
12. $10\frac{4}{7}-7\frac{5}{12}$
13. $16\frac{1}{3}-9\frac{3}{14}$
14. $8\frac{2}{9}-3\frac{6}{7}$
15. $4\frac{1}{5}-2\frac{7}{12}$

143. 1. $\$17\frac{1}{4}$ are how much more than $\$8\frac{7}{20}$?

2. How much added to $9\frac{3}{8}$ ft. will make $14\frac{1}{5}$ ft.?

3. A having $\$17\frac{3}{4}$, paid B $\$9\frac{3}{5}$; how much had he left?

4. $9\frac{4}{11}-7\frac{1}{3}$
5. $12\frac{4}{9}-7\frac{4}{7}$
6. $15\frac{2}{3}-13\frac{11}{12}$
7. $14\frac{2}{9}-7\frac{5}{8}$
8. $12\frac{2}{15}-8\frac{7}{12}$
9. $18\frac{2}{3}-9\frac{11}{15}$
10. $11\frac{4}{5}-9\frac{7}{10}$
11. $22\frac{4}{9}-3\frac{11}{12}$
12. $16\frac{3}{7}-7\frac{7}{12}$
13. $9\frac{4}{9}-7\frac{5}{7}$
14. $8\frac{5}{6}-5\frac{8}{9}$
15. $8\frac{1}{3}-5\frac{11}{25}$

16. How much has C left of $\$41\frac{1}{4}$ after spending $\$15\frac{11}{20}$?

17. What number taken from $49\frac{5}{8}$ leaves $17\frac{7}{15}$?

18. How much does $85\frac{2}{3}$ ft. lack of being $111\frac{7}{8}$ ft.?

19. $275\times396,\div125,\div99=$?

144. 1. From $15\frac{5}{6}+17\frac{7}{15}$ take $19\frac{3}{5}+7\frac{5}{12}$.

2. How many yards of cloth in 4 remnants, containing $7\frac{2}{3}$ yd., $8\frac{3}{4}$ yd., $3\frac{1}{2}$ yd. and $4\frac{5}{6}$ yd.?

3. I paid out \$$6\frac{3}{4}$, \$$7\frac{4}{5}$, \$$5\frac{7}{10}$, and had \$29 left; how much had I at first?

4. A man starts on a journey of $74\frac{4}{5}$ miles; after traveling $38\frac{5}{8}$ miles, how far has he still to go?

5. $640 - 358\frac{11}{16} = ?$ 6. $(17\frac{3}{4}+5\frac{9}{10}) - 18\frac{5}{8} = ?$

7. A lady having \$23, paid \$$5\frac{7}{10}$ for a hat, \$$3\frac{3}{4}$ for cloth, and \$$7\frac{4}{5}$ for a shawl; how much had she left?

8. What cost 45 lb. of tea at 38 cents a pound?

9. Divide \$568.75 by \$8.75. 10. Divide 648.55 by 76.3.

145. 1. What number is $17\frac{5}{9}$ less than $29\frac{7}{8}$?

2. At \$8.75 per bbl., how many bbl. of flour cost \$2100?

3. A boy had \$$8\frac{7}{20}$, earned \$$5\frac{3}{4}$, then spent \$$2\frac{1}{2}$ for a sled, and \$$8\frac{4}{5}$ for a watch; how much had he left?

4. A man bought a farm of 268 acres at \$57.20 per acre, and sold it for \$16500; find his gain.

5. $29\frac{5}{8}$ yd. — ($12\frac{4}{9}$ yd. + $14\frac{5}{6}$ yd.) = ? Make a problem.

6. \$2384 were paid for 298 bbl. of flour, which was sold at \$9 per bbl.; how much was gained?

7. Divide 39058 by 708. 8. Divide \$783 by \$.90.

9. Find $\frac{1}{79}$ of 47365. 10. Multiply \$5.35 by 64.

146. 1. Add $3\frac{5}{8}$, $12\frac{5}{6}$, $17\frac{3}{4}$, $9\frac{7}{12}$ and $7\frac{9}{16}$.

2. What cost 9 pieces of cloth, 47 yd. each, at \$.35 per yd.?

3. 29 lb. of butter cost \$14.50; what cost 54 lb.?

4. A lady having \$$27\frac{1}{2}$, paid \$$2\frac{3}{4}$ for gloves, \$$3\frac{3}{5}$ for silk, and \$$8\frac{7}{10}$ for a bonnet; how much had she left?

5. A clerk earns \$75 a month; he pays \$27.50 for board, \$3.75 for washing, and \$15.75 for other expenses; how much may he save each month? in 7 months?

6. Multiply 7746 by 907 7. $15\frac{4}{5} - (3\frac{7}{8}+7\frac{7}{10}) = ?$

8. Divide \$169 by \$3.25. 9. Find $\frac{1}{19}$ of \$11.40.

10. A horse which cost \$175, was sold at a loss of $\frac{1}{7}$ of the cost; find the selling price.

11. Add 78, 95, 576, 794, 986, 68, 89 and 587.

147. 1. The sum of two amounts is $\$7\frac{4}{5}$, the less is $\$2\frac{5}{8}$; what is the greater?

2. A boy earned $\$7\frac{3}{4}$, sold his skates for $\$3\frac{2}{5}$, then bought a sheep for $\$4\frac{4}{5}$; how much had he left?

3. From a farm of $159\frac{4}{5}$ acres, the owner sold $37\frac{5}{8}$ acres, then bought $78\frac{19}{80}$ acres; how much land now in the farm?

4. An office boy earns \$.75 a day; how long will it take him to earn \$12?

5. How many cows at \$28.75 a head, cost \$546.25?

6. Add \$39.65, \$18.84, \$78.69, \$9.78, \$37.67 and \$47.79.

7. Multiply \$321.08 by 38.
8. From $309\frac{1}{2}$ take $78\frac{35}{78}$.

9. Divide 347692 by 702.
10. Find $\frac{1}{98}$ of \$509.60.

148. 1. If 36 mules cost \$2304, how much will 29 cost?

2. A trader bought 297 bbl. of apples at \$2.95 per bbl., and sold the lot for \$1125; find his profit.

3. If $87\frac{5}{8}$ lb. of flour be taken from a full barrel, how many pounds are left? (Table, p. 92.)

4. $\$278\frac{4}{5}$ are how much more than $\$189\frac{17}{25}$?

5. John has $\$73\frac{5}{8}$, and George has $\$17\frac{4}{5}$ less than he; how much have they both?

6. Add 9328, 797, 5948, 39627, 7269, 89378, 8593, 7278, 796, 9878 and 3794.

7. $35\frac{7}{12}-(9\frac{5}{6}+17\frac{5}{9})=?$
8. $(\$9\frac{5}{8}+\$7\frac{3}{4})-\$12\frac{5}{6}=?$

9. Divide 104762 by 961.
10. Divide 833382 by 832.

149. 1. How many hours in 29 days and 18 hours?

2. The product of two numbers is \$8100; one of them is 675; what is the other?

3. Multiply \$.78 by 87. Make a problem for this example.

4. Sold a suit of clothes which cost \$24, at a loss of $\$7\frac{11}{20}$; find the selling price.

5. How many square yards in a floor 18 ft. by 14 ft.?

6. Paid \$22.65 for a harness, and 3 times as much for a cart; how much did both cost?

7. Multiply \$85.67 by 49.
8. $(3\frac{5}{7}+5\frac{5}{6})-2\frac{17}{21}=?$

9. Take \$85.83 from \$104.
10. $19\frac{4}{15}-(3\frac{5}{6}+8\frac{5}{8})=?$

11. Find all the factors or divisors of 96; of 130.

IV. MULTIPLICATION.

150. In Multiplication of Fractions, one factor or both are fractional, or mixed numbers.

Examples. — 1. What cost 5 books at $\$\frac{3}{4}$ each? (S. 16.)

ANALYSIS. — At $\$\frac{3}{4}$ each, 5 books cost 5 times 3 *fourths of a dollar*, or 15 *fourths of a dollar*, or $\$3\frac{3}{4}$. Since the denominator of the fraction simply tells the name of the fractional units, the operation is not unlike one in simple multiplication; that is, the numerator is simply multiplied by the multiplier, and the resulting fraction, $\$\frac{15}{4}$, is then changed to a mixed number.

OPERATION. — $5\times\$\frac{3}{4}=\$\frac{15}{4}$ or $\$3\frac{3}{4}$.

2. Multiply $\frac{5}{8}$ by 4. (S. 16.)

ANALYSIS. — 4 times *one eighth* equal *one half*, and 4 times *five* eighths equal *five halves*, or $2\frac{1}{2}$. In the operation, if the example were solved as the preceding, '4 times 5' becomes the numerator of a fraction, $\frac{20}{8}$; then '4×5' is a dividend and 8 a divisor, and, applying Prin. II., Art. 120, the result is $\frac{5}{2}$, or $2\frac{1}{2}$.

OPERATION. — $\cancel{4}\times\frac{5}{\cancel{8}_{2}}=\frac{5}{2}$, or $2\frac{1}{2}$.

3. Find $\frac{2}{3}$ of $\frac{2}{5}$. (S. 16.)

ANALYSIS. — $(\frac{2}{5}=\frac{6}{15},)$ $\frac{1}{3}$ of $\frac{2}{5}=\frac{2}{15}$, and $\frac{2}{3}$ of $\frac{2}{5}=\frac{4}{15}$.

In this example, the first result is found by separating $\frac{2}{5}$ into $\frac{6}{15}$, the second by taking *one third* of these, which multiplied by 2, gives $\frac{4}{15}$. It is readily seen that the fractional units are really separated into smaller fractional units. If the fractions were written in the form, $\frac{2}{3}\times\frac{2}{5}$, and the denominators multiplied together for a new denominator, and the numerators for a new numerator, the result would be the same. The operation *is called Multiplication of Fractions;* but, see Art. 176.

In the expression $\frac{2}{3}\times\frac{6}{7}$, the sign is read '*of.*'

In the example $\frac{2}{3}$ of $\frac{6}{7}$, or $\frac{2}{3}\times\frac{6}{7}$, we might say: "1 *third* of $\frac{6}{7}$ is $\frac{2}{7}$, and 2 *thirds* of $\frac{6}{7}$ are 2 times $\frac{2}{7}$, or $\frac{4}{7}$," — canceling as in the margin.

$\frac{2}{\cancel{3}}\times\frac{\cancel{6}^{2}}{7}=\frac{4}{7}$

151. Exercises. — *Oral and Written.* —

1. What cost 7 yards of cloth at $\$\frac{3}{5}$ a yard?

2. What cost 4 pounds of tea at $\$\frac{5}{8}$ per pound?

3. How many bushels of oats are there in 3 sacks, each containing $2\frac{1}{2}$ bushels? (S. 2.)

4. $5\frac{1}{2}$ yd. make a rod; how many in 5 rods?

5. $8\times\frac{2}{7}$
6. $7\times\frac{3}{5}$
7. $3\times\frac{7}{9}$
8. $3\times\frac{9}{11}$
9. $5\times\frac{5}{12}$
10. $8\times\frac{8}{9}$
11. $7\times\frac{11}{21}$
12. $8\times\frac{9}{10}$
13. $4\times\frac{7}{12}$
14. $11\times\frac{5}{8}$
15. $7\times\frac{5}{14}$
16. $8\times\frac{7}{19}$

152. 1. How many yards in 7 rods? in 70 rods?

2. Tom has $\$1\frac{3}{4}$, and Dick has 5 times as much; how much has he? how much have both?

3. How much will 9 hats cost at $\$4\frac{2}{5}$ each?

4. At $\$3\frac{5}{8}$ a head, what cost 10 sheep? 20 sheep?

5. $3\times5\frac{2}{3}$
6. $7\times4\frac{2}{5}$
7. $8\times7\frac{2}{3}$
8. $9\times2\frac{2}{5}$
9. $8\times2\frac{5}{6}$
10. $3\times9\frac{5}{8}$
11. $3\times7\frac{6}{7}$
12. $16\times3\frac{3}{4}$
13. $13\times3\frac{3}{11}$
14. $24\times2\frac{5}{8}$
15. $21\times16\frac{1}{2}$
16. $36\times5\frac{5}{8}$

153. 1. What cost $5\frac{1}{2}$ cords of wood at \$3 a cord?

2. What cost $3\frac{3}{4}$ bushels of potatoes, at $\$\frac{3}{5}$ per bu.?

3. 246 cords of wood cost \$848.70; what cost 187 cords?

4. Multiply $365\frac{3}{4}$ by 9; $543\frac{5}{8}$ by 7. (S. 17.)

5. $3\frac{1}{3}\times\frac{7}{8}$
6. $7\frac{1}{2}\times\frac{4}{5}$
7. $7\frac{2}{3}\times\frac{4}{9}$
8. $4\frac{1}{2}\times\frac{2}{15}$
9. $5\frac{1}{2}\times16$
10. $1\frac{5}{6}\times9$
11. $16\frac{1}{2}\times21$
12. $3\frac{5}{8}\times24$
13. $7\frac{4}{5}\times30$
14. $4\frac{5}{6}\times27$
15. $3\frac{5}{8}\times18$
16. $2\frac{3}{11}\times13$

154. 1. $2\frac{1}{4}$ yd. of silk cost how much at $\$2\frac{2}{5}$ a yard?

2. How many yards in $5\frac{2}{3}$ rods? how many feet?

3. What is the value of $3\frac{1}{2}$ tons of hay at $\$4\frac{2}{5}$ a ton?

4. What cost $6\frac{2}{3}$ dozen hats at $\$18\frac{3}{4}$ per dozen?

5. $3\frac{1}{2}\times1\frac{1}{4}$
6. $1\frac{3}{4}\times1\frac{1}{2}$
7. $2\frac{1}{3}\times1\frac{3}{4}$
8. $2\frac{3}{4}\times3\frac{1}{3}$
9. $3\frac{1}{5}\times2\frac{1}{2}$
10. $7\frac{1}{2}\times3\frac{1}{5}$
11. $3\frac{3}{4}\times3\frac{1}{6}$
12. $8\frac{1}{2}\times1\frac{1}{9}$
13. $8\frac{1}{3}\times3\frac{4}{5}$
14. $1\frac{1}{8}\times4\frac{5}{9}$
15. $7\frac{1}{3}\times1\frac{1}{11}$
16. $3\frac{3}{5}\times7\frac{2}{9}$

155. 1. How many bu. of corn, at \$.375 per bu., cost \$28.50?

2. Add 3978, 796, 28594, 7938, 5946, 7698, 7439 and 996.

3. How many days in 16 years of $365\frac{1}{4}$ days each?

4. Multiply $583\frac{7}{8}$ by 6.

5. Multiply $56\frac{5}{6}$ by $18\frac{3}{4}$.

6. Multiply \$58.35 by 79.

7. Divide 78306 by 978,

156. 1. What cost $\frac{3}{4}$ of a yd. of cloth at $\$\frac{3}{8}$ per yd.?

2. A owns $\frac{2}{3}$ of a mill, and B owns $\frac{3}{5}$ as much; what part of the mill does B own? what part do both own?

3. What cost $\frac{3}{4}$ of an ounce of quinine at $\$\frac{9}{10}$ per oz.?

4. $\frac{2}{3}$ of $\frac{5}{6}$
5. $\frac{7}{8}$ of $\frac{4}{5}$
6. $\frac{2}{9}$ of $\frac{5}{8}$
7. $\frac{2}{5}$ of $\frac{7}{9}$
8. $\frac{3}{5}$ of $\frac{4}{5}$
9. $\frac{7}{8}$ of $\frac{8}{11}$
10. $\frac{6}{7}$ of $\frac{8}{11}$
11. $\frac{7}{8}$ of $\frac{11}{12}$
12. $\frac{2}{11}$ of $\frac{6}{7}$
13. $\frac{9}{10}$ of $\frac{17}{21}$
14. $\frac{7}{9}$ of $\frac{5}{16}$
15. $1\frac{2}{3}$ of $\frac{13}{15}$

157. 1. A has $\$6\frac{3}{4}$ and B has $\frac{2}{3}$ as much; how much has B?

2. A man having a field of $7\frac{1}{2}$ acres, sold $\frac{3}{5}$ of it; how many acres did he sell? how much was left?

3. What cost $\frac{5}{8}$ of a yard of velvet at $\$4\frac{2}{5}$ per yard?

4. $\frac{3}{5}$ of $4\frac{1}{6}$
5. $\frac{3}{7}$ of $8\frac{2}{5}$
6. $\frac{5}{8}$ of $8\frac{4}{5}$
7. $\frac{2}{7}$ of $1\frac{5}{9}$
8. $\frac{3}{5}$ of $7\frac{2}{3}$
9. $\frac{5}{6}$ of $7\frac{5}{9}$
10. $\frac{5}{12}$ of $3\frac{3}{7}$
11. $\frac{7}{15}$ of $1\frac{3}{8}$
12. $\frac{9}{11}$ of $18\frac{1}{3}$
13. $\frac{3}{7}$ of $7\frac{7}{8}$
14. $\frac{5}{9}$ of $6\frac{3}{10}$
15. $\frac{5}{7}$ of $11\frac{3}{8}$

158. 1. How many inches in $7\frac{2}{9}$ yards? (S. 2 and 10.)

2. How many cu. ft. in $5\frac{1}{2}$ cu. yd.? (Table, p. 88.)

3. What cost 1280 pencils at $2\frac{1}{2}$ cents each?

4. A man paid out $\$7\frac{3}{4}$ at one time, $\$15\frac{3}{5}$ at another, and had $\$29\frac{1}{2}$ left; how much had he at first?

5. $2\frac{3}{4} \times 568$
6. $4\frac{2}{5} \times 520$
7. $7\frac{2}{3} \times 125$
8. $7\frac{2}{7} \times 448$
9. $3\frac{5}{6} \times 715$
10. $12\frac{2}{5} \times 307$
11. $23\frac{3}{4} \times 85$
12. $38\frac{3}{5} \times 647$

159. 1. A lady having $\$23\frac{1}{2}$, paid $\$1\frac{3}{4}$ for vegetables, $\$3\frac{7}{10}$ for groceries, and $\$7\frac{3}{5}$ for coal; how much had she left?

2. What cost 324 yd. of cloth at $2\frac{3}{5}$ per yd.?

3. A house and lot worth \$7560, lacks how much of being worth as much as 146 acres of land at $\$68\frac{1}{2}$ per acre?

4. A man who earns \$24 a week and spends \$17 a week, may save \$245 in how many weeks?

5. $(12\frac{3}{5}+7\frac{7}{8})-17\frac{3}{4}=?$
6. $(5\frac{2}{3}\times 7)-19\frac{3}{7}=?$
7. Divide 53070 by 280.
8. $(7\frac{1}{2}\times \$3\frac{3}{4})+\$15\frac{3}{5}=?$

160. 1. Add \$7.59, \$29.48, \$38, \$11.56, \$8.78, \$98.17 and \$8.76.

2. The divisor is \$5.90 the quotient is 870; find the dividend.

3. How many 17-cent books will \$85 pay for?

4. Take $\$39\frac{7}{8}$ from $\$47\frac{1}{2}$.
5. Find $\frac{2}{5}$ of \$10.40.
6. Divide \$76.50 by 6 cents.
7. Divide \$3768 by \$.75

161. 1. How much added to $\$47\frac{2}{5}$ will equal the value of 156 bushels of potatoes at $\$\frac{3}{8}$ per bushel?

2. $19\frac{3}{4}$ yd. of cloth cost how much, at $\$2\frac{1}{2}$ per yd.?

3. Mr. Jones' house cost \$4500, which was twice the cost of the lot; how much did both cost?

4. Bought 24 yd. of cloth at $\$.37\frac{1}{2}$ a yard, and paid for it with eggs at \$.15 a dozen; how many dozen were required?

5. How many feet in 254 rods? in 1500 inches?

6. Add \$7.27, \$9.38, \$35.14, \$9.16, \$18.07, \$14.86 and \$76.45.

7. $8\frac{3}{4} \times \$157 = ?$ 8. $9 \times 342\frac{3}{8} = ?$

9. $7 \times (18 - 7\frac{4}{9}) = ?$ 10. $\$516 \times 7\frac{3}{4} = ?$

162. 1. What is the value of 8 pieces of cloth, each containing 37 yards each, at $12\frac{1}{2}$ cents a yard?

2. A man having $\$127\frac{3}{4}$, received $\$116\frac{9}{20}$ for work, then paid out $\$188\frac{1}{2}$; how much had he left?

3. How much added to the difference between $\$15\frac{2}{9}$ and $\$7\frac{3}{4}$ will make $\$14\frac{5}{8}$?

4. What will $2\frac{1}{2}$ tons of hay cost, when 4 tons cost \$27?

5. When 4 cords of wood cost \$14.80, what cost $6\frac{1}{2}$ cords?

6. How much added to \$12.64 will make $\$21\frac{1}{4}$?

7. \$18.59 taken from how much leave \$19.67?

8. What 7 dozen pairs of shoes at $\$2\frac{5}{8}$ per pair?

9. Divide 130295 by 289. 10. Find $\frac{1}{79}$ of 14376.

163. 1. Change $17\frac{1}{2}$ to *twelfths; to hundredths.*

2. The sum of three numbers is $3\frac{5}{8}$, one is $1\frac{1}{4}$, another is $\frac{9}{20}$; find the third.

3. At $\$1\frac{3}{4}$ per rod, what cost a ditch a mile long?

4. How many acres in 7 lots, each containing $37\frac{3}{8}$ acres?

5. How many gallons in 176 barrels? (Table, p. 85.)

6. Paid \$131.15 for 61 sheep; find the price per head.

7. At \$7.80 per ton, what cost $3\frac{1}{2}$ tons of hay?

8. Divide 180000 by 288. 9. Multiply \$78.09 by 58.

10. Add 79, 587, 948, 83, 7504, 9387, 859 and 746.

11. \$56 are 4 fifths of how many times \$8?

12. Find the L. C. M. of 18, 24, 15 and 40.

13. Find the G. C. D. of 96 and 160; of 289 and 510.

V. DIVISION.

164. In Division of Fractions, the divisor or dividend or both are fractional, or mixed numbers.

Examples. — 1. How many lb. of tea, at $\$\frac{3}{4}$ per lb., cost $6?

ANALYSIS. — (1.) At $\$\frac{3}{4}$ per lb., as many pounds of tea cost $6, as $\$\frac{3}{4}$ are contained times in $6. $6 equal 24 *fourths of a dollar*, and 3 *fourths of a dollar* are contained in 24 *fourths of a dollar* 8 times, etc. (S. 16.)

That is, when the numbers have the same fractional unit, the operation is like one in simple division.

(2.) At $\$\frac{1}{4}$ per lb., $1 will pay for 4 lb.; at $\$\frac{3}{4}$ per lb., $1 will pay for $\frac{1}{3}$ as many pounds, or $\frac{4}{3}$ lb., and $6 will pay for 6 times as many pounds, or 8 lb.

OPERATION. —

$\$6 \div \$\frac{3}{4} =$

$\overset{2}{\cancel{6}} \times \frac{4}{\cancel{3}} = 8$

That is, if the terms of the divisor be *transposed*, the quotient of *one* divided by the divisor is found; this multiplied, the dividend gives the quotient of the *dividend* divided by the divisor; so, it is said: " At $\$\frac{3}{4}$ of a dollar per lb., $1 will pay for $\frac{4}{3}$ lb., and $6 will pay for 6 times $\frac{4}{3}$ lb., or 8 lb."

Or, *One* divided by $\frac{3}{4}$ equal $\frac{4}{3}$, and 6 divided by $\frac{3}{4}$ equals 6 times $\frac{4}{3}$, or 8, canceling as in the margin. (S. 16.)

2. At $\$\frac{2}{5}$ per yd., how many yards of silk cost $\$4\frac{1}{2}$?

ANALYSIS. — $1 divided by $\$\frac{2}{5}$ equals $\frac{5}{2}$, and $\$4\frac{1}{2}$ divided by $\$\frac{2}{5}$ equal $\frac{9}{2}$ of $\frac{5}{2}$, or $\frac{45}{4}$, or $11\frac{1}{4}$ yd.

OPERATION. —

$\$4\frac{1}{2} \div \$\frac{2}{5} = \frac{9}{2} \times \frac{5}{2} = \frac{45}{4}$, $11\frac{1}{4}$.

So, also, $3\frac{1}{3} \div 2\frac{1}{2} = \frac{\overset{2}{\cancel{10}}}{3} \times \frac{2}{\cancel{5}} = \frac{4}{3}$, or $1\frac{1}{3}$.

3. 5 yd. of cloth cost $\$\frac{3}{4}$; find the price per yard.

ANALYSIS. — One yard costs *one fifth* of $\$\frac{3}{4}$, or $\$\frac{3}{20}$.

OPERATION.

$\frac{1}{5} \times \$\frac{3}{4} = \$\frac{3}{20}$

This is said to be an example in Division of Fractions; it is simply a '*separation*' of the fraction into a number of equal parts to find one of the parts. (S. 16.)

165. Exercises. — Oral and Written. —

1. How many lb. of tea, at $\$\frac{2}{5}$ per lb., cost $4?
2. At $\$\frac{3}{8}$ per yd., how many yd. of cloth cost $45?
3. If a man plow $\frac{5}{8}$ of an acre in a day, in how many days ca he plow 9 acres?
4. Paid $10 for oil at $\$\frac{3}{5}$ per gal.; how much was bought?
5. $8 \div \frac{5}{6}$
6. $7 \div \frac{3}{7}$
7. $9 \div \frac{2}{3}$
8. $15 \div \frac{5}{8}$
9. $9 \div \frac{4}{7}$
10. $11 \div \frac{5}{8}$
11. $12 \div \frac{4}{7}$
12. $7 \div \frac{4}{9}$
13. $21 \div \frac{14}{15}$
14. $52 \div \frac{4}{5}$
15. $75 \div \frac{5}{6}$
16. $90 \div \frac{3}{4}$

166. 1. $\$2\frac{1}{2}$ pay for how much sugar, at $\$\frac{1}{10}$ per lb.?

2. $\$2\frac{3}{5}$ buy how many lb. of butter, at $\$\frac{3}{20}$ per lb.?
3. How many baskets, each holding $\frac{3}{8}$ of a bushel, will hold $4\frac{1}{2}$ bushels of plums?
4. $\frac{1}{2} \div \frac{2}{5}$
5. $6\frac{1}{4} \div \frac{5}{8}$
6. $7\frac{1}{2} \div \frac{5}{8}$
7. $3\frac{1}{7} \div \frac{2}{3}$
8. $2\frac{1}{10} \div \frac{3}{5}$
9. $3\frac{5}{9} \div \frac{3}{4}$
10. $6\frac{2}{5} \div \frac{4}{5}$
11. $2\frac{1}{4} \div \frac{9}{28}$
12. $18\frac{3}{8} \div \frac{5}{8}$
13. $3\frac{2}{3} \div \frac{11}{18}$
14. $4\frac{1}{6} \div \frac{5}{12}$
15. $31\frac{1}{4} \div \frac{3}{8}$

167. 1. How many coats may be made from $7\frac{1}{2}$ yd. of cloth, if $2\frac{1}{2}$ yd. are required for each?

2. At $\$3\frac{3}{4}$ each, how many hats cost $\$11\frac{1}{4}$?
3. How many sheep, at $\$5\frac{1}{4}$ each, cost $\$52\frac{1}{2}$?
4. $1\frac{1}{2} \div 1\frac{1}{4}$
5. $2\frac{2}{3} \div 1\frac{1}{3}$
6. $4\frac{1}{2} \div 2\frac{1}{6}$
7. $7\frac{1}{2} \div 1\frac{1}{8}$
8. $9\frac{1}{3} \div 2\frac{1}{3}$
9. $12\frac{1}{4} \div 3\frac{1}{2}$
10. $5\frac{1}{3} \div 1\frac{7}{9}$
11. $7\frac{1}{2} \div 1\frac{1}{6}$
12. $5\frac{5}{9} \div 2\frac{1}{6}$
13. $12\frac{1}{2} \div 1\frac{3}{5}$
14. $16\frac{1}{3} \div 1\frac{1}{6}$
15. $24\frac{1}{2} \div 2\frac{1}{10}$

168. 1. At how much each, do 5 hats cost $\$6\frac{1}{4}$?

2. 8 pears weigh $4\frac{2}{3}$ lb.; find their average weight.
3. $\frac{5}{8}$ of a barrel of flour was divided equally among ten persons; what part of the barrel did each receive?
4. $7\frac{1}{3} \div 4$
5. $3\frac{2}{3} \div 5$
6. $4\frac{2}{5} \div 6$
7. $5\frac{3}{4} \div 9$
8. $9\frac{2}{3} \div 7$
9. $12\frac{1}{2} \div 5$
10. $9\frac{3}{5} \div 12$
11. $7\frac{3}{8} \div 9$

169. 1. How many yards in $475\frac{2}{3}$ ft.? (S. 18.)

2. 5 men have $\$1783\frac{1}{2}$; how much has each?
3. How many pecks in $193\frac{3}{4}$ quarts?
4. $287\frac{3}{4} \div 5$
5. $852\frac{4}{5} \div 4$
6. $953\frac{2}{5} \div 7$
7. $758\frac{2}{5} \div 9$
8. $920\frac{5}{8} \div 6$
9. $759\frac{4}{9} \div 8$
10. $1005\frac{3}{8} \div 6$
11. $1147\frac{3}{8} \div 4$
12. What is a fraction? the denominator of a fraction?
13. How is a fraction reduced to lower terms?

170. 1. Add $17\frac{5}{8}$, $19\frac{11}{12}$, $17\frac{5}{9}$, $13\frac{1}{2}$ and $27\frac{5}{6}$.

2. What cost $27\frac{3}{4}$ tons of coal at $\$3\frac{7}{8}$ per ton?

3. What number added to $\frac{19}{21}$ gives $2\frac{1}{12}$?

4. Is $7\times\frac{5}{9}$ equal to $\frac{5}{9}$ of 7? Why? (Art. 47, III.)

5. How many bbl. of flour, at $\$7\frac{3}{4}$ per bbl., cost $31?

6. If $6 pay for $\frac{4}{5}$ of a ton of coal, $4 pay for how much?

7. How many rods in 1320 yards? in 1286 ft.?

8. How many books at $\$\frac{3}{20}$ each can I buy for $\$6\frac{3}{4}$?

9. Paid $\frac{1}{3}$ of my money for a hat, and $\frac{1}{2}$ of it for a coat, and had $\$2\frac{1}{2}$ left; what had I at first?

10. A's money is $\frac{1}{2}$ of B's, and both have $45; how much has each?

171. 1. What number multiplied by 77 gives 6468?

2. If $\$\frac{3}{5}$ buy a yard of cloth, how much will $\$7\frac{1}{2}$ buy?

3. $11\frac{1}{2}$ bbl. of flour cost $\$43\frac{1}{8}$; find the price per bbl.

4. Tom worked 3 times as many days as John, and both earned $56; how much did each earn?

5. A can build a shed in 4 days, B in 6 days; in how many days can they build it working together?

6. At $\$2\frac{3}{5}$ per day, how much will a man earn in 7 weeks?

7. How many square feet in a room $17\frac{1}{2}$ ft. by $11\frac{3}{4}$ ft.?

8. What are the divisors of 81? of $56?

9. $16\frac{2}{3}$ yd. of cloth cost $20; find the price per yard.

10. $(173-49\frac{7}{8})\times9\frac{3}{4}=?$ 11. $(\$5\frac{3}{5}\div\$1\frac{3}{4})\times29=?$

172. 1. A has $\$39\frac{2}{5}$ and B has $\$17\frac{3}{4}$ less than A; how much have they both?

. What cost $156\frac{3}{4}$ yd. of cloth at $\$\frac{2}{3}$ per yd.?

3. 75 cents were divided between two boys so that one received 2 cents as often as the other received 3 cents; how much had each?

4. What number divided by $\$7\frac{5}{8}$ gives $5\frac{2}{3}$?

5. How many rods of fence will enclose a field 40 rods long and 32 rods wide? (S. 10.)

6. $(\$7\frac{3}{8}-\$1\frac{3}{5})\times24=?$ 7. $(\$\frac{2}{5}\times19)+(\$1\frac{3}{4}\times23)=?$

8. $(\$5\frac{2}{5}\times63)\div\$1\frac{2}{3}=?$ 9. $\$55\div7\frac{1}{2}$ ct.$=?$

10. What is necessary before fractions may be added?

173. 1. $\$29\frac{1}{5}$ are how much more than $\$17\frac{5}{8}$?

2. What number multiplied by $7\frac{1}{2}$ gives $10\frac{17}{20}$?

3. If 7 yd. of cloth cost $\$4\frac{3}{8}$, how much will $4\frac{1}{2}$ yd. cost?

4. If $1\frac{1}{4}$ yd. of cloth cost $\$4\frac{1}{2}$, what cost $9\frac{3}{4}$ yd.?

5. 4 tons of hay cost $27; how much will $7\frac{1}{2}$ tons cost?

6. What cost $19\frac{1}{2}$ tons of coal at $\$3\frac{3}{5}$ a ton, and 75 bushels of oats at $\$\frac{1}{4}$ per bushel?

7. How many yards in 78 miles? (Table, page 86.)

8. Bought 17 lb. of beef at 16 cents a pound, $28\frac{1}{2}$ lb. of mutton at 12 cents a pound, and 17 lb. of pork at 9 cents a pound; what was the amount of the bill?

9. Add $12\frac{2}{3}$, $17\frac{5}{8}$ and $19\frac{7}{16}$. 10. $(12\frac{2}{5}+17\frac{3}{4})-19\frac{5}{6}=$?

174. 1. At $\$2\frac{3}{4}$ each, how many sheep cost $\$93\frac{1}{2}$?

2. At $\$2\frac{3}{8}$ per bbl., how much will 14 bbl. of salt cost?

3. 928 bbl. of flour, which cost $\$9\frac{1}{2}$ per bbl., were sold for $8790; how much was gained or lost?

4. A man who spends $\$1\frac{7}{8}$ for cigars each week, will waste $\$22\frac{1}{2}$ in how many weeks?

5. A farm of 160 acres cost $6000; find the price per acre.

6. A dealer bought 7000 bu. of wheat at $.87 per bushel; he sold half of it at $.85 per bushel, and the remainder at $.95 per bushel; how much did he gain?

7. $(27\frac{3}{8}+11\frac{7}{12})-23\frac{7}{9}=$? 8. $(5\frac{2}{3}\times3\frac{1}{5})+8\frac{3}{4}=$?

9. $(7\frac{1}{2}\times5\frac{2}{3})\div2\frac{3}{8}=$? 10. $\$5.50\times67\frac{1}{2}=$?

175. 1. Find the L. C. M. of 10, 24, 32 and 25.

2. $1\frac{1}{8}$ yd. of cloth cost $.72; what cost $7\frac{1}{2}$ yd.?

3. At $\$\frac{3}{8}$ per yd., how many yd. of cloth cost $64?

4. What cost 28 acres of land at $17.80 per acre?

5. What cost $19\frac{3}{4}$ cords of wood, at $\$2\frac{3}{8}$ per cord?

6. A broker paid $2760 for 4520 bushels of corn; 1750 bushels were destroyed by fire, and the remainder was sold at $.60 per bushel; how much did he lose?

7. $(7\frac{1}{2}\times1\frac{2}{3})\div15\frac{5}{8}=$? 8. $(7\frac{2}{3}\times5\frac{1}{5})\div37\frac{3}{8}=$?

9. $(5\frac{2}{5}\times3\frac{1}{3})\div3\frac{5}{8}=$? 10. $(4\frac{2}{3}\times3)+(2\frac{1}{3}\times\frac{3}{5})=$?

11. What amount multiplied by $7\frac{1}{2}$ gives $14.85.

12. Of what use is the L. C. M. of numbers?

176. Parts of Numbers are found by separation and multiplication. See ex. 3, Art. 150, and ex. 3, Art. 164.

177. Exercises. — Oral and Written. —

1. John paid $\$7\frac{1}{2}$ for 5 chickens; what did each cost?

2. A has 644 acres of land; B has $\frac{1}{7}$ as many; how many has B? How many have both?

3. I pay $\frac{3}{5}$ of \$750 for a horse; what does it cost?

4. Find $\frac{3}{5}$ of $7\frac{1}{3}$ rods. 5. Find $\frac{5}{9}$ of $18\frac{3}{4}$ yd.

6. $\frac{3}{4}$ of 75 8. $\frac{3}{8}$ of $121\frac{1}{3}$ 10. $\frac{4}{5}$ of $273\frac{3}{4}$ 12. $\frac{7}{12}$ of $145\frac{3}{4}$
7. $\frac{5}{7}$ of $4\frac{2}{3}$ 9. $\frac{5}{9}$ of 278 11. $\frac{5}{8}$ of $97\frac{1}{9}$ 13. $\frac{7}{8}$ of $411\frac{1}{5}$

178. 1. A owns a lot containing $\frac{3}{4}$ of an acre; if he sell $\frac{2}{5}$ of it to B, how much will B have?

2. A farmer having 736 sheep, sold $\frac{5}{8}$ of them; how many did he sell?

3. What cost $\frac{3}{4}$ of a yard of velvet at $\$1\frac{7}{12}$ per yard?

4. $\frac{3}{5}$ of $\frac{13}{15}$ 6. $\frac{7}{12}$ of $\frac{45}{50}$ 8. $\frac{5}{11}$ of $\frac{47}{75}$ 10. $\frac{14}{15}$ of $\frac{25}{56}$
5. $\frac{4}{9}$ of $\frac{75}{96}$ 7. $\frac{3}{7}$ of $\frac{91}{96}$ 9. $\frac{5}{13}$ of $\frac{65}{90}$ 11. $\frac{17}{18}$ of $\frac{45}{51}$

179. 1. 4 tons of coal cost $\$27\frac{1}{5}$; what cost 24 tons?

2. A man having $\$127\frac{3}{4}$, received $\$175\frac{7}{20}$ for a horse, then paid out $\$258\frac{1}{2}$; how much had he left?

3. A clerk bought a house and lot for \$5850, paid \$675 for improvements, then sold the property for $\frac{1}{5}$ as much more than it cost; find his gain.

4. The divisor is \$18, the quotient 24, and the remainder \$12; find the dividend.

5. 15 bbl. of apples cost $\$18\frac{3}{4}$ at how much per bbl.?

6. How many 49-pound sacks of flour in 298 bbl.?

7. Multiply $\$2\frac{3}{8}$ by 64. Make a problem.

8. Add $5\frac{2}{3}$, $6\frac{3}{4}$, $7\frac{4}{15}$, $8\frac{5}{16}$ and $9\frac{7}{12}$.

9. Divide $\$258\frac{1}{4}$ by \$6. 10. Find $\frac{7}{8}$ of $516\frac{1}{2}$ ft.

180. 1. If $\frac{3}{8}$ of a lot containing $7\frac{3}{4}$ acres of land be sold, how much is left?

2. What cost $5\frac{3}{8}$ tons of hay, at $\$18\frac{3}{4}$ per ton?

3. How many tons of coal, at $\$7\frac{3}{4}$ per ton, cost \$60?

4. Multiply \$78 by $16\frac{3}{4}$. 5. Divide \$156 by $\$7\frac{2}{3}$.

6. $(5\frac{3}{8} \times \$7\frac{3}{4}) + \$56\frac{4}{5} = ?$ 7. $9\frac{3}{7} \times (5\frac{1}{4} + 3\frac{5}{7}) = ?$

181. 1. What is the price per yard, if $\frac{2}{3}$ of a yard of cloth cost $\$\frac{4}{5}$?

2. How many feet in $\frac{3}{4}$ of a yard?

3. Find $\frac{5}{7}$ of \$98. Make a problem.

4. I paid $\frac{2}{5}$ of my money for a suit of clothes, and had \$47.40 left; how much had I at first?

5. A farm was sold for \$9250, which was $\frac{5}{7}$ of the cost; how much was lost?

6. Sold a horse for \$165, gaining $\frac{1}{10}$ of the cost; how much did it cost?

7. What cost 319 bbl. of pork at $\$9\frac{3}{8}$ per bbl.?

8. $39\frac{5}{8}$ are $\frac{5}{8}$ of what? 9. Divide $1759\frac{5}{12}$ by 9.

10. $\frac{9}{11}$ of a number are $5\frac{5}{8}$; find $\frac{17}{18}$ of it.

182. 1. $\$7\frac{3}{8}$ are $\frac{5}{12}$ of how much?

2. $128\frac{3}{4}$ yards are $2\frac{3}{5}$ times how many yards?

3. $15\frac{1}{3}$ rods are $2\frac{1}{2}$ times how many yards?

4. A's carriage cost $\$126\frac{1}{2}$; if this was $\frac{2}{3}$ of the cost of his horse, how much did both cost?

5. What cost 5 lb. of butter, if $1\frac{1}{2}$ lb. cost 30 cents?

6. What cost $7\frac{1}{2}$ quarts of milk at 20 cents a gallon?

7. What cost $8\frac{3}{4}$ tons of coal, if $\frac{4}{5}$ of a ton cost $\$3\frac{3}{5}$?

8. $726\frac{2}{3} \div 9\frac{2}{3} = ?$ 9. Divide $\$105\frac{7}{10}$ by $3\frac{1}{2}$ ct.

10. What cost 17 bbl. of sugar, 298 lb. each, at $\$.08\frac{3}{8}$ per lb.?

183. 1. $\$17\frac{1}{5}$ are $\frac{2}{9}$ of how much?

2. What cost $\frac{3}{4}$ of 1000 bricks at $1\frac{1}{4}$ cents each?

3. Divide $\$87\frac{3}{4}$ by $\$\frac{1}{2}$. 4. Divide 73498 by 986.

5. I have \$760, and $\frac{3}{4}$ of my money equal $\frac{5}{6}$ of B's; how much have I more than he?

6. $17\frac{6}{7}$ are $8\frac{2}{5}$ times how many?

7. 720 acres of land were sold for \$28800, at a gain of $\frac{1}{4}$ of the cost; find the cost per acre?

6. $\frac{1}{3}$ of A's money is $\frac{2}{3}$ of B's, and both have \$180; how much has each?

7. $58\frac{1}{3}$ are $\frac{7}{24}$ of how many? 8. Divide $3158\frac{2}{9}$ by 7.

9. What cost 5 bushels 3 pecks of potatoes, at \$1 per bu.?

10. How many years in 7350 days?

184. The Relation of Numbers is found by analysis.

Examples. — 1. 9 are what part of 15? or, what is the relation of 9 to 15?

ANALYSIS. — 1 is *one fifteenth* of 15, and 9 are nine times one fifteenth of 15, or three fifths of 15.

OPERATION. —

$$\frac{3}{\cancel{9}}\times\frac{1}{\underset{5}{\cancel{15}}}=\frac{3}{5}$$

2. $\frac{2}{3}$ are what part of $1\frac{3}{4}$?

ANALYSIS. — $1\frac{3}{4}$ equals $\frac{7}{4}$; $\frac{1}{4}$ is *one seventh* of $\frac{7}{4}$; 1 is four sevenths of $\frac{7}{4}$, and $\frac{2}{3}$ (of 1) are $\frac{2}{3}$ of $\frac{4}{7}$ of seven fourths, or $\frac{8}{21}$ of seven fourths.

OPERATION. —

$$\frac{2}{3} \text{ of } \frac{4}{7}=\frac{8}{21}$$

3. 21 are $\frac{3}{5}$ of how many?

ANALYSIS. — If 21 are 3 fifths of some number, 1 fifth of the number is 1 third of 21, and 5 fifths of the number are $\frac{5}{3}$ of 21, or 35.

OPERATION. —

$$\frac{5}{3} \text{ of } \cancel{7}1=35$$

4. $2\frac{1}{3}$ are $1\frac{1}{2}$ times what number?

ANALYSIS.— $2\frac{1}{3}=\frac{7}{3}$; $1\frac{1}{2}=\frac{3}{2}$. If $\frac{7}{3}$ are $\frac{3}{2}$ of some number, $\frac{1}{2}$ of the number is $\frac{1}{3}$ of $\frac{7}{3}$, and the whole number is $\frac{2}{3}$ of $\frac{7}{3}$, or $\frac{14}{9}$, or $1\frac{5}{9}$.

OPERATION. —

$$\frac{2}{3} \text{ of } \frac{7}{3}=\frac{14}{9}, \text{ or } 1\frac{5}{9}$$

185. Exercises. —

1. 8 are what part of 12?
2. Divide $7385\frac{5}{6}$ by 8.
3. 12 are what part of 35?
4. Multiply $2779\frac{6}{7}$ by 9.
5. \$720 are $\frac{2}{3}$ of my money; how much have I?
6. $\frac{3}{4}$ of 48 are $\frac{9}{10}$ of what number?
7. $16\frac{2}{3}$ yards are $\frac{4}{9}$ of how many yards?
8. What cost $\frac{3}{4}$ of a mill, if $\frac{3}{5}$ of it cost \$4200?
9. $(17\frac{3}{8}+19\frac{5}{6})-28\frac{7}{9}=$?
10. $7\frac{3}{4}\times\frac{3}{5}$ of $7\frac{1}{2}=$?

186. 1. A boy paid $\frac{3}{5}$ of his money for a sled costing \$3.60; how much had he left?

2. \$$8\frac{2}{5}$ are what part of \$20?
3. $4\frac{2}{7}$ are $\frac{3}{5}$ of what?
4. \$$4\frac{1}{2}$ are $1\frac{1}{2}$ times how much?
5. $7\frac{2}{3}$ are $\frac{3}{5}$ of what?
6. \$$56\frac{1}{4}$ are $\frac{9}{32}$ of how much? $2\frac{1}{4}$ times how much?
7. $\frac{2}{3}$ of a number are $7\frac{1}{4}$; find the number.
8. $\frac{2}{3}$ of $6\frac{3}{4}$ are how many times $1\frac{2}{5}$?

187. 1. How many feet in $\frac{7}{8}$ of a mile? in $\frac{3}{5}$ rd.?

2. A farmer harvested 2850 bushels of wheat from a field of 75 acres, which he sold at \$.85 per bushel; what was the value of what each acre produced?

3. $1\frac{1}{3}$ yd. of cloth cost 72 cents; what cost $\frac{5}{8}$ yd.?

4. The divisor is \$27.50, the quotient 38, the remainder \$16.37; find the dividend.

5. $\$29\frac{1}{5}$ are how much more than $\$17\frac{5}{16}$?

6. Mr. Jones' house cost \$3650, which is twice the cost of the lot; how much did both cost?

7. $\frac{2}{3}$ of $(\$5.64 \times 5\frac{1}{2}) = ?$

8. $46\frac{5}{9} + 23\frac{7}{24} + 18\frac{13}{15} = ?$

9. $\$25 \div \$\frac{2}{5} = ?$

10. $(\$7\frac{1}{2} \times 5\frac{2}{3}) \div \$2\frac{3}{8} = ?$

188. 1. I paid out \$27.20, which was $\frac{2}{3}$ as much as I had left; how much had I at first?

2. A owned $\frac{7}{12}$ of a mill, which was sold for \$8320; what was his share of the money?

3. B, owning $\frac{5}{9}$ of a mill, sold $\frac{3}{4}$ of his share for \$7290; what was the value of the mill?

4. If you have \$62.50, how many sheep, at \$3 a head, can you buy?

5. $\frac{3}{4}$ of the value of a horse are \$70.50; find $\frac{4}{5}$ of the value.

6. $\frac{11}{14}$ of $51\frac{1}{3} \div \frac{3}{8}$ of $4\frac{4}{9} = ?$

7. $(12\frac{5}{8} \div 3\frac{1}{3}) \times 3\frac{3}{7} = ?$

8. Factor 2754.

9. $\$30\frac{1}{4} \div \$16\frac{2}{3} = ?$

10. What cost 7 lb. 12 oz. of butter at \$.40 per pound?

189. 1. 56 are $\frac{7}{8}$ of how many? $2\frac{2}{3}$ times how many?

2. What part of 48 are $3\frac{1}{7}$?

3. $\frac{5}{9}$ are what part of $2\frac{1}{2}$?

4. $7\frac{3}{8}$ are $\frac{5}{8}$ of how many?

5. $\$96\frac{1}{2}$ are $\frac{8}{9}$ of what?

6. $\frac{5}{7}$ of the value of a vessel are \$25000; what is the value of $\frac{12}{25}$ of it?

7. $\$18\frac{3}{4}$ were paid for $\frac{3}{8}$ of an acre of land; what part of an acre would \$24 purchase?

8. 5 men earn $\$67\frac{1}{2}$ in 4 days; how much will 7 men earn in 6 days? in $12\frac{1}{2}$ days?

9. A drover paid \$6050 for 76 mules; find the average price.

10. What part of 13 ft. are 5 ft.? of $3\frac{1}{4}$ ft. are $2\frac{1}{2}$ ft.?

11. $3\frac{1}{7}$ are what part of 44? of $6\frac{2}{7}$?

190. Exercises for Oral Analysis. —

1. Bought flour at $7 per bbl., and sold it at $9 per bbl., gaining $28; how many barrels did I sell?

2. $24 were lost on cloth bought at $6 per yd. and sold at $4; how much did it cost?

3. Joe travels 4 miles per hour, and Tom 5 miles; if they start from the same place and travel in opposite directions, how far apart will they be in 8 hours?

4. 5 times $8, plus 9 times $6, will buy how many barrels of flour at $8 per barrel?

5. What cost 7 yd. of cloth at $\$2\frac{2}{5}$ per yd.?

6. How many books at $\$\frac{3}{5}$ each cost as much as 8 slates at $\$\frac{9}{10}$ each?

7. What part of $4\frac{1}{2}$ are $1\frac{1}{3}$? 8. $3\frac{1}{2}$ are $\frac{5}{8}$ of what?

9. How many are $\frac{5}{8}$ of $7\frac{1}{2}$? 10. $\$5\frac{2}{5}$ are $\frac{3}{7}$ of what?

191. 1. What cost $\frac{5}{8}$ yd. of velvet at $\$2\frac{3}{4}$ a yard?

2. What cost $5\frac{3}{4}$ tons of hay, if 8 tons cost $64?

3. How many dozen eggs at 12 cents a dozen, will pay for 20 yd. of muslin at 12 cents a yard?

4. What cost 9 weeks' board, when 5 cost $27?

5. Rob picked 9 qt. of cherries; Tom picked $7\frac{1}{2}$ qt. more than $2\frac{2}{3}$ times as many; how many did both pick?

6. What cost 1 yd. of muslin, when $\frac{5}{8}$ yd. cost 15 cents?

7. What cost 7 acres of land, if $\frac{5}{8}$ of an acre cost $44?

8. What cost $5\frac{3}{4}$ lb. of butter, when $\frac{3}{4}$ lb. cost $\$.18\frac{3}{4}$?

9. $2\frac{2}{3}$ lb. of cheese cost $.40; what cost $7\frac{1}{2}$ lb.?

10. $7\frac{1}{2}$ lb. of sugar cost $.60; what cost $9\frac{3}{4}$ lb.?

192. 1. Sue is 15 years old, and $\frac{2}{3}$ of her age are $\frac{5}{7}$ of Mary's age; how old is Mary?

2. George has $15, and $1\frac{2}{3}$ times his money are $2\frac{1}{2}$ times what Will has; how much have both?

3. What cost 3 lb. 4 oz. of butter, when $7\frac{1}{2}$ lb. cost $.90?

4. What cost 7 hats, when $1\frac{1}{2}$ dozen cost $45?

5. $\frac{5}{12}$ are what part of $1\frac{2}{3}$? 6. $\$2\frac{7}{8}$ are $\frac{5}{8}$ of what?

7. Divide $540\frac{3}{4}$ by 6. 8. Multiply $71\frac{3}{5}$ by 4.

9. $13\frac{1}{3}$ ft. $\div$ $1\frac{1}{2}$ ft. $=$? 10. Find $\frac{3}{4}$ of 750.

193. 1. What cost 48 trees, if 12 cost $\$7\frac{1}{2}$?

2. How many bu. of corn at $\$\frac{3}{8}$ per bu., cost $\$12\frac{1}{2}$?

3. How many strings $2\frac{2}{3}$ ft. long will a 30-ft. cord make?

4. 5 times $\frac{2}{3}$ of 20 are how many times $\frac{1}{2}$ of 11?

5. If I earn as much as I now have, and $\frac{1}{2}$ as much more, I shall have $75; how much have I now?

6. $\frac{3}{5}$ of a number are $4\frac{1}{2}$ more than $\frac{1}{2}$ of it; find the number.

7. After paying $\frac{2}{3}$ of my money for books and $\frac{1}{5}$ of it for a slate, I had $.30 left; how much did each cost?

8. If A sell $\frac{1}{3}$ of his sheep to B, and $\frac{1}{4}$ to C, he will sell 7 more to B than to C; how many has he?

9. $3\frac{2}{3}$ are $\frac{3}{5}$ of how many? 10. Find $\frac{7}{9}$ of $5\frac{2}{5}$.

194. 1. A can build a barn in 4 days, B in 6 days; how long should it take them together?

2. A can finish a work in 4 days, B in 4 days, and C in 8 days; how long should it take them all together?

3. In a school there are 60 pupils, and 3 girls to every 2 boys; how many are there of each?

4. I have $\$7\frac{1}{2}$; if $\frac{2}{3}$ of my money equals $\frac{1}{2}$ of yours, how much have we both?

5. Find $\frac{5}{7}$ of $3\frac{2}{3}$. 6. $\$9\frac{4}{5}$ are $3\frac{1}{2}$ times what?

7. What part of $\$3\frac{1}{5}$ are $\$3\frac{2}{3}$? 8. $\$56\frac{1}{4}$ are $\frac{5}{11}$ of what?

9. Multiply $97 by 9. 10. Take $3.75 from $11.

195. 1. A and B can build a cabin in 9 days, B can build it alone in 15 days; how long should it take A alone?

2. A kite string 175 yd. long broke, and the kite flew off with $\frac{2}{3}$ as much as was left; how much was lost?

3. What number plus $\frac{2}{3}$ of itself, is 36 more than $\frac{1}{2}$ of it?

4. A girl will earn how much in 5 weeks, if she earns $\$22\frac{1}{2}$ in $4\frac{1}{2}$ weeks?

5. Sam earns $35 a month, and it takes him $\frac{3}{5}$ of a month to earn as much as Harry earns in $\frac{3}{4}$ of a month; how much does Harry earn per month?

6. Arthur has $100, and $\frac{3}{5}$ of his money less $16 are $\frac{11}{16}$ as much as Rob has; how much have both?

7. $\frac{3}{4}$ of 30 are $\frac{5}{8}$ of what? 8. From $28.50 take $9.25.

DECIMALS
AND
UNITED STATES MONEY.

I. NOTATION AND REDUCTIONS.

196. If a unit be separated into *ten* equal parts, each part is *one tenth* ($\frac{1}{10}$); if each of these parts be separated into *ten* equal parts, each part is (one tenth of a tenth, or) *one hundredth* ($\frac{1}{100}$); if each of these parts be separated into *ten* equal parts, each part is (one tenth of a hundredth, or) *one thousandth* ($\frac{1}{1000}$); etc. These parts are called *decimal parts*, and the fractions formed are *Decimal Fractions*.

197. A Decimal Fraction is one in which the unit is separated into *tenths*, *hundredths*, *thousandths*, etc.

By means of the *Decimal Point*, (.), a decimal fraction may be written without its denominator, — the name of the denominator being shown by the place or order in which the right hand figure of the numerator is found. Decimal fractions so written are called simply **Decimals.**

The decimal point is always found at the right of *ones* or primary units — See the Table of Orders, Art. 16, page 8; the first place or order at the right of the decimal point is *tenths*, the second place is *hundredths*, the third place is that of *thousandths*, the fourth place is that of *ten-thousandths*, etc. The number 7.56 is read, *seven* and *fifty-six hundredths;* the number 9.0875 is read, *nine* and *eight hundred seventy-five ten-thousandths.*

198. A number composed of an integer and a decimal is a **Mixed Decimal**; thus, 7.8 is a mixed decimal. If a decimal and a common fraction are united, the number is a **Complex Decimal**; thus, $.8\frac{1}{3}$ and $\$5.18\frac{3}{4}$ are Complex decimals.

NOTE. — A mixed decimal corresponds to a mixed number, and a complex decimal to a complex fraction, in Common Fractions.

199. To read a decimal, — *Read the number as an integer, giving it the name of the right hand order* Thus, 5.0087 is read, *five* and *eighty-seven ten-thousandths.*

In reading mixed decimals, the decimal point is read '*and.*'

200. To write a fractional number as a decimal, — *Write the numerator so that its right hand figure shall occupy the place having the name of the fractional unit, filling the unused places with ciphers.*

201. Exercises. —

I. Read the following numbers:

1. .7; .17
2. .05, .37
3. .125, .206
4. .130, 5.76
5. 2.53, 8.07
6. 5.764
7. 90.078
8. 19.435
9. 123.509
10. 208.018
11. .6235
12. .0206
13. .2039
14. 2.0106
15. 75.0074
16. 200.005
17. .205
18. $.87\frac{1}{2}$
19. $4.16\frac{2}{3}$
20. $9.06\frac{1}{4}$

II. Write the following numbers in figures:

1. 8 hundredths.
2. 2 and 5 hundredths.
3. 716 thousandths.
4. 375 ten-thousandths.
5. Two hundred seven thousandths.
6. Two hundred and seven thousandths.
7. Three hundred six and eighty-four thousandths.
8. Two hundred fifty-six ten-thousandths.
9. Ninety and fifteen thousandths.
10. Forty and six hundred two hundred-thousandths.
11. Two and four hundred seventy thousandths.

202. Principles. — *I. Annexing decimal ciphers to a number does not change its value.* Thus, .5=.50, .500, etc.

II. Omitting decimal ciphers from the right of a number does not change its value. Thus, .50=.5; 3.800=3.8; etc.

III. Removing the decimal point in any number one place to the right, multiplies the number by 10; two places, by 100; etc.

IV. Removing the decimal point in any number one place to the left, divides the number by 10; two places, by 100; etc.

Principles I. and II. correspond to Principles I. and II., Art. 120. See also Principles II., III., IV. and V., Art. 18.

203. *A decimal may be changed to a common fraction* by writing the numerator without the decimal point and with its proper denominator, then reducing the resulting fraction to its lowest terms. Thus, $.75=\frac{75}{100},=\frac{3}{4}$.

204. *A common fraction may be changed to a decimal* by annexing decimal ciphers to the numerator, and dividing the resulting decimal by the denominator of the fraction. Thus, $\frac{5}{8}=\frac{1}{8}$ of 5.000, or .625. The analysis of the operation is, $\frac{5}{8}=\frac{1}{8}$ of 5; 5= 5.000, and $\frac{1}{8}$ of $5=\frac{1}{8}$ of 5.000, or .625.

If $\frac{5}{7}$ be reduced to a decimal, the result is $.7142\frac{6}{7}$, and to whatever order the division be carried, there will always be a remainder. Such common fractions, when reduced to decimals, give rise to *Complex Decimals*. (S. 19.)

205. Many common fractions are readily reduced to decimals by *inspection*.

The following decimal equivalents of the common 'aliquot parts,' if committed to memory, may be found very useful. —

$\frac{1}{2}=.5$
$\frac{1}{3}=.33\frac{1}{3}$
$\frac{2}{3}=.66\frac{2}{3}$
$\frac{1}{4}=.25$
$\frac{3}{4}=.75$
$\frac{1}{5}=.2$
$\frac{2}{5}=.4$
$\frac{3}{5}=.6$
$\frac{4}{5}=.8$
$\frac{1}{6}=.16\frac{2}{3}$
$\frac{5}{6}=.83\frac{1}{3}$
$\frac{1}{8}=.12\frac{1}{2}$
$\frac{3}{8}=.37\frac{1}{2}$
$\frac{5}{8}=.62\frac{1}{2}$
$\frac{7}{8}=.87\frac{1}{2}$
$\frac{1}{12}=.08\frac{1}{3}$
$\frac{5}{12}=.41\frac{2}{3}$
$\frac{7}{12}=.58\frac{1}{3}$
$\frac{11}{12}=.91\frac{2}{3}$
$\frac{1}{16}=.06\frac{1}{4}$
$\frac{3}{16}=.18\frac{3}{4}$
$\frac{5}{16}=.31\frac{1}{4}$
$\frac{7}{16}=.43\frac{3}{4}$
$\frac{9}{16}=.56\frac{1}{4}$
etc.

206. Exercises. — I. Change to common fractions:

1. .75
2. .125
3. .075
4. .750
5. .032
6. .0625
7. .9375
8. .5625
9. .3125
10. .0242
11. .808
12. .0128
13. .2215
14. .8848
15. .0095
16. 8.375
17. 2.256
18. $1.33\frac{1}{3}$
19. $5.56\frac{1}{4}$
20. $7.45\frac{1}{2}$

II. Change to decimals:

1. $\frac{4}{5}$
2. $\frac{5}{8}$
3. $\frac{1}{6}$
4. $\frac{5}{6}$
5. $\frac{3}{7}$
6. $\frac{3}{16}$
7. $\frac{15}{16}$
8. $\frac{9}{25}$
9. $\frac{17}{20}$
10. $\frac{13}{16}$
11. $\frac{5}{7}$
12. $\frac{7}{9}$
13. $\frac{8}{11}$
14. $\frac{9}{14}$
15. $\frac{15}{24}$
16. $\frac{21}{48}$
17. $\frac{4}{21}$
18. $\frac{7}{32}$
19. $\frac{39}{40}$
20. $\frac{29}{56}$
21. $\frac{3}{14}$
22. $\frac{19}{21}$
23. $\frac{15}{38}$
24. $\frac{15}{17}$
25. $\frac{31}{160}$

207. United States Money is written as decimals.

Table.

10 mills = 1 cent (ct. or ¢),
10 cents = 1 dime,
10 dimes = 1 dollar ($).

The *Dollar* is the standard unit; *Dimes* and *Cents* are written as *tenths* and *hundredths*, and *Mills* as *thousandths* of a dollar or parts of a cent. Dimes and cents are read together as cents, and mills sometimes as parts of a cent. Thus, — 5 dollars, 4 dimes, 6 cents and $2\frac{1}{2}$ mills are written: $5.4625, or $\$5.46\frac{1}{4}$, and read: 5 dollars $46\frac{1}{4}$ cents.

208. In results, in trade and accounts, it is customary to disregard parts of a cent when less than half a cent in value, and to call the cents one more if the value of the fraction is greater than half a cent.

209. Exercises. — I. Read the following amounts:

1. $5.07
2. $50.50
3. $.365
4. $.375
5. $.5625
6. $9.875
7. $\$4.06\frac{1}{4}$
8. $\$15.08\frac{1}{3}$
9. $7.6875
10. $46.937
11. $1000.80
12. $200.706

II. Write in figures:

1. 4 dollars $37\frac{1}{2}$ cents.
2. 93 dollars 70 cents.
3. 6 dollars $6\frac{1}{4}$ cents.
4. $8\frac{1}{3}$ cents.
5. 8 dollars, 18 cents 5 mills.
6. 34 dollars, 7 cents 6 mills.
7. 17 dollars, 14 cents $7\frac{1}{2}$ mills.
8. 9 dollars $66\frac{2}{3}$ cents.

III. Change: (S. 8 and 9.)

1. 5635 cents to dollars.
2. $8706\frac{1}{2}$ cents to dollars.
3. 9485 mills to dollars.
4. $8.73 to cents.
5. $6.35 to dimes.
6. $4.70 to mills.

7. 36 acres of land, which cost $3780, were sold for $4260; how much would be gained on 54 acres bought and sold at the same rate?

8. $7\frac{1}{2}$ yd. of cloth cost $\$4\frac{1}{2}$; what cost $12\frac{1}{2}$ yd.?

9. How many miles in 87568 feet?

10. Add $186\frac{5}{9}$, $428\frac{7}{24}$, $759\frac{7}{8}$ and $384\frac{11}{12}$.

11. $2\frac{3}{4}$ times $\$7\frac{1}{3}$, plus $\$28\frac{5}{9}$ are how much?

12. Define mixed number; similar fractions; complex decimal.

II. ADDITION.

210. The process in Addition of Decimals and U. S. Money is the same as in Integers. For convenience, the numbers are arranged so that the decimal points will be found in a column. (S. 7.)

211. Exercises. —

1.	2.	3.	4.	5.
\$9.15+	19.75+	\$273.80+	38.78+	\$3.94+
27.40	95.46	59.46	97.7	37.05
8.76	4.375	70.28	6.05	9.625
14.88	28.5	347.95	54.407	18.90

6. A man sold a horse for \$87.50, losing \$8.75; what was the cost of the horse?

7. A furniture dealer sold a sofa for \$18.50, a set of chairs for \$12.75, a bureau for \$28.60, and a book case for \$21.75; what was the amount of the sale?

8. A farm of 283 acres, which cost \$58.50 per acre, was sold at a gain of \$9.75 per acre; find the selling price.

9. Change $\frac{28}{125}$ to a decimal. 10. Divide $6147\frac{5}{6}$ by 9.

212. 1. A boy paid \$.70 for a grammar, \$.55 for a slate, \$1.45 for a geography, \$.75 for a reader, and had \$3.85 left; how much had he at first?

2. A dealer bought coal at \$3.70 a ton and sold it at a gain of \$.85 a ton; find the selling price.

3. Add $5\frac{4}{5}$, $6\frac{5}{6}$, $7\frac{6}{7}$, and $8\frac{7}{8}$.

4.	5.	6.	7.	8.
\$7.58+	93.75+	\$13.70+	58.9+	\$9.72+
39.46	109.5	8.95	4.384	$8.56\frac{1}{2}$
12.93	74.87	6.375	59.67	37.54
29.78	58.225	14.0625	32.09	$9.62\frac{1}{2}$
8.95	12.57	5.87	5.053	58.47
17.05	94.075	12.625	24.78	$29.37\frac{1}{2}$

213. 1. If 5 men build a wall in $7\frac{1}{2}$ days, how long should it take 9 men?

2. A horse cost \$145, a carriage $\frac{7}{8}$ as much; how much did both cost?

3. A farm of 125 acres cost \$5125; for how much per acre must it be sold to gain \$2500?

4. Add 29.005, 7.863, 67.58, 9.125, 13.24, 98.7 and 6.08.

5. Add \$19.67, \$5.96, \$8.37, \$15.11, \$3.84, \$9.60 and \$7.15.

6. The divisor was 873, the quotient 358, and the remainder 195, what was the dividend?

7. Divide 2000000 by 873. 8. Multiply 956 by $7\frac{3}{8}$.

9. $(7\frac{2}{3} \times \$7\frac{1}{2}) + \$38\frac{1}{2} = ?$ 10. $(8\frac{5}{8} + 9\frac{5}{12}) - (7\frac{2}{3} + 6\frac{7}{15}) = ?$

214. 1. A set out on a journey of 863 miles; after traveling 35 miles a day for 19 days, how far had he to go?

2. What sum of money is $\$78\frac{5}{8}$ more than $\$116\frac{4}{5}$?

3. 450 bbl. of flour are worth how much at $\$8\frac{3}{8}$ per bbl.?

4. $27\frac{1}{2} \times \$3\frac{4}{5}$ are how much more than $\frac{5}{8}$ of $\$78\frac{1}{5}$?

5. A has 728 sheep, B has 8 times as many lacking 3027; how many has B more than A?

6. At $\$7\frac{3}{5}$ per bbl., what cost \$256 bbl. of apples?

7. 5 lb. of butter cost $\$\frac{17}{20}$; what cost 19 lb.?

8. Add 75.02, 9.308, 23.5, 756.058, 78.15 and 9.0375.

9. Divide $3\frac{3}{7}$ by $\frac{3}{7}$ of $1\frac{1}{2}$. 10. $\$1536\frac{1}{4} - \$878\frac{3}{5} = ?$

215. 1. How many inches in $278\frac{1}{2}$ yards?

2. How many seconds in a day?

3. What cost 17 brooms at $\$3\frac{1}{2}$ a dozen?

4. How many square yards in a floor 17 ft. by 15 ft.?

5. What cost 7 lb. 12 oz. of butter at \$.40 per lb.?

6. What part of \$18 are $\$7\frac{1}{2}$? 7. $7\frac{1}{2}$ are $\frac{5}{16}$ of what?

8. $\frac{12}{17}$ of \$340 are $2\frac{1}{2}$ times how much?

9. What is $\frac{3}{8}$ of a number, if \$91 are $\frac{7}{50}$ of it?

10. Add \$17.56, \$29.37, \$12.98, \$43.71, \$49.08, \$83.79, \$127.80, \$276.75, \$39.56, \$56.74 and \$19.78.

11. Divide $8736\frac{2}{5}$ by 8. 12. Multiply $359\frac{5}{6}$ by 7.

13. When is a fraction in its lowest terms?

14. How is a common fraction changed to a decimal?

III. SUBTRACTION.

216. The process in Subtraction of Decimals and U. S. Money is the same as in Subtraction of Integers. For convenience, the decimal point in the subtrahend is placed under that of the minuend.

217. Exercises. —

1.	2.	3.	4.	5.
$9.35 —	97.215 —	$315.00 —	736.4 —	$427.20 —
4.83	34.927	149.75	378.25	281.45

6. A lady went shopping with $27; she paid $13.60, for a dress and $3.30 for a hat; how much had she left?

7. The loss on a harness sold for $22.40, was $3.65; how much did it cost?

8. A dealer sold a horse for $145, at a gain of $22.75; how much did the horse cost him?

9. From four hundred and sixteen thousandths take two hundred eighty-seven ten-thousandths.

10. If you sell a pair of skates for $2.75, then earn $2.75, how much will you lack of having $9?

218. 1. A man owned .375 of a mill, bought .25 more, then sold $\frac{5}{16}$ of it; what part did he still own?

2. A man bought a building lot for $550, built a house on it for $3760, paid $168.75 for repairs and insurance, then sold the property for $4725; find the gain.

3. What cost $27\frac{3}{4}$ tons of coal at $\$3\frac{1}{5}$ a ton?

4. $\$271\frac{1}{2}$ will buy how many bu. of oats at $\$\frac{1}{4}$ per bu.?

5. A man born in 1808, lived 74 years; in what year did he die?

6. Find the G. C. D. of 24, 36 and 16; their L. C. M.

7.	8.	9.	10	11.
19.57 —	$297.12 —	74. —	$1000.50 —	$504.58 —
7.363	158.70	59.378	713.75	357.67

219. 1. A traveled 59.8 miles one day, 83.48 on another, and 56.625 on a third; how far in the three days?

2. I have but $90.25, how much do I lack of having enough to buy a watch worth $87.50 and a chain worth $18.80?

3. A tailor had two pieces of cloth containing 38.25 yd. and 34.875 yd.; he used 19.5 yd. from one, and 23.25 yd. from the other; how many yards were left?

4. How many feet in 298 rods $7\frac{1}{2}$ feet?

5. What number taken from 3 will leave 1.56?

6. What number multiplied by 297 gives 239075?

7. $\$56.70-\$28.375=?$ 8. $(\$58.65+\$9.60)-\$75.80=?$

9. $107.9-53.0817=?$ 10. $(19.587+9.67)-18.0705=?$

220. 1. Bought a suit of clothes for $23.75, a hat for $7.25, a pair of shoes for $8.60, and a pair of gloves for $2.25; how much did I receive in change for a 50-dollar bill?

2. A man purchased a horse for $185, and a carriage for $253.80; he paid $280.30 down, and gave his note for the balance; for how much was the note given?

3. The sum of three numbers is $\$17\frac{4}{5}$; one of them is $\$3\frac{1}{2}$, another is $\$5\frac{3}{4}$; find the third.

4. Add $48\frac{17}{84}$, $69\frac{19}{42}$ and $56\frac{15}{56}$. 5. Take $59\frac{5}{9}$ from $87\frac{3}{8}$.

6. $36 are $\frac{5}{8}$ of what? 7. $(\$2\frac{3}{5}\times 8)-(\$7\frac{1}{2}\times 1\frac{1}{3})=?$

8. By what must $\$2\frac{3}{8}$ be multiplied to give $\$4\frac{3}{4}$?

9. Multiply $573\frac{5}{8}$ by 6. 10. Divide $\$723\frac{4}{5}$ by 8.

221. 1. $16\frac{2}{3}$ are $\frac{4}{9}$ of $\frac{1}{2}$ of what number?

2. What is $\frac{1}{8}$ of A's money, if $\frac{3}{5}$ of it are $\$121\frac{1}{2}$?

3. $\$\frac{4}{5}$ multiplied by what number will give $\$7\frac{3}{4}$?

4. $\frac{2}{3}$ of 5 are how many times $\frac{3}{8}$ of 9?

5. Which is greater $\frac{5}{8}$ or $\frac{5}{9}$? Why?

6. What is the relation of $\$5\frac{1}{3}$ to $\$17\frac{1}{2}$?

7. How many cubic feet in $28\frac{1}{2}$ cubic yards?

8. At $\$7\frac{1}{2}$ a ton, how much hay will cost $\$4\frac{1}{2}$?

9. $\$325\div\$1.50=?$ Make a problem.

10. A jeweler sold a watch for $\$62\frac{1}{2}$, which was $1\frac{1}{5}$ times the cost; what was his profit?

11. How many yards in $7\frac{1}{2}$ miles?

IV. MULTIPLICATION.

222. In Multiplication of Decimals and U. S. Money, one factor or both are in the form of decimals.

If the multiplier be an integer, the process is the same as in Multiplication of Integers, and the product has the same fractional unit as the multiplicand, — that is, it is of the same order. Thus, 3 times 4.5 equal 13.5.

If the multiplier be a decimal, the process is the same in principle as that in finding a part of an integer or fraction, the numerator in the result being the product of the numerators of the factors, and the denominator being the product of the denominators of the factors.

Thus, $\frac{5}{10}\times\frac{3}{10}=\frac{15}{100}$, or $.5\times.3=.15$,
$\frac{3}{10}\times\frac{7}{100}=\frac{21}{1000}$, or $.3\times.07=.021$; in like manner, $7.3\times.03=.219$, and $1.2\times1.2=1.44$.

From these examples, it is seen that, when either or both factors are decimals, *the product contains as many decimal places as there are in both factors.*

NOTE. — Any number is multiplied by 10, 100, 1000, etc., by applying Principle III., Art. 202, filling the unused places, if any, with ciphers.

223. Exercises. —

1. 3.7×5
2. 5.3×7
3. $5.37×9
4. $4.25×25
5. $15.7×3.5
6. $6.45×.88
7. 5.07×3.6
8. .475×.54
9. What cost 37 yd. of broadcloth at $4.25 per yd.?
10. There are 5.5 yd. in 1 rod; how many in 37 rods?

224. 1. What cost 36 doz. eggs at $.06¼ a dozen?

2. 7.5×.09
3. .56×.37
4. $5.25×3.8
5. $7.10×7.6
6. 9.3×9.76
7. .075×8.8
8. 5.4×7.05
9. 3.57×4.08
10. A merchant sold 32 pieces of muslin, each 33.5 yd., at $.14 a yard; find the amount of the bill.
11. 324 tons of coal, costing $3.12½ a ton, were sold at $3.85 a ton; how much was gained?
12. What cost 56.875 acres of land at $87.50 per acre?

225. 1. How many gallons in 39 bbl., averaging 31.5 gal.?

2. At $4.25 a ton, what cost 8.5 tons of hay?

3. What cost 23.5 lb. of butter at $\$.37\frac{1}{2}$ per lb.?

4. What cost 100 railway ties at $\$.18\frac{3}{4}$ each?

5. A lady paid $7.50 for a hat, twice as much for a dress, and $5.80 for a pair of shoes; how much did she pay for all?

6. $\$73.30 \times 4.5$
7. $\$15.50 \times 1.6$
8. $2.79 \times .35$
9. $\$.625 \times 324$
10. $\$8.60 \times 9.25$
11. $.73 \times 250$

226. 1. 16.5 ft. make 1 rod; how many feet in 3 miles?

2. A dealer paid $29.70 for a 44-gallon cask sirup, which he sold at $.75 per gal.; find his profit.

3. What is the value of 28 chests of tea, each containing 59 lb., at $.28 per lb.?

4. A farmer owing $9540, gave in payment 38 acres of land at $37.50 per acre, and $4500 in cash; how much did he still owe?

5. $\$9.43 \times 100$
6. $\$.0625 \times 288$
7. $.47 \times .08$
8. $\$.35 \times 1000$
9. $\$5.40 \times 33\frac{1}{3}$
10. $\$1.05 \times 500$

227. 1. A boy worked 171 days at $.75 a day; what was the amount of his wages?

2. The divisor is $27.25, the quotient 38, the remainder $14.38; what is the dividend?

3. $6\frac{5}{9}+9\frac{23}{24}+8\frac{11}{15}=?$

4. Find $\frac{3}{8}$ of $5\frac{2}{3} \times \$1\frac{3}{4}$.

5. A man earns $\$2.25$ a day, and a boy $\$1.12\frac{1}{2}$; how much will both earn in 38 days?

6. 23.60×45
7. $\$16.30 \times 8.5$
8. $\$1.12\frac{1}{2} \times 76$
9. $.275 \times 128$
10. $.62\frac{1}{2} \times 2400$
11. $.35 \times 450$

228. 1. A man bought 85 acres of land at $47.25 per acre, and paid down $2875; how much remained unpaid?

2. $(\$7\frac{1}{2} \times 2\frac{2}{3})+\$18\frac{3}{5}=?$

3. $\$3\frac{3}{8}$ are $\frac{3}{5}$ of what?

4. $\$.68 \times 167.5$
5. $\$.37\frac{1}{2} \times 8.4$
6. $.067 \times 2000$
7. $.509 \times 4000$
8. $\$.18\frac{3}{4} \times 2800$
9. $\$6.75 \times 66\frac{2}{3}$

10. What part of $3\frac{2}{5}$ are $2\frac{5}{8}$?

11. Divide $593\frac{5}{7}$ by 6.

12. $7\frac{4}{5}$ are $3\frac{3}{4}$ times what number?

13. How many inches in a rod?

V. DIVISION.

229. In Division of Decimals and U. S. Money, the dividend or divisor or both are in the form of decimals.

If the divisor be an integer, the process is the same as in Division of Integers, or in finding a part of a number, and the quotient has the same fractional unit as the dividend, — that is, it is of the same order. Thus, $17.24÷$4=4.31, and one fifth of 2.25=.45. (S. 19.)

If the divisor be a decimal, the process is the same in principle as that in dividing by a common fraction, the numerator of the divisor being taken as a divisor to find another factor of the dividend, —that is, the process is the converse of that in Multiplication of Decimals. Thus, —

.7 × .5 = .35, then .35 ÷ .5 = .7, and .35 ÷ .7 = .5,
.4 × .17 = .068, then .068 ÷ .4 = .17, and .068 ÷ .17 = .4,
6.8 × .003 = .0204, then .0204 ÷ .003 = 6.8, and .0204 ÷ 6.8 = 003,
5.24 × 5 = 26.2, then 26.2 ÷ 5 = 5.24, and 26.2 ÷ 5.24 = 5.

From these examples, it is seen that, when either the dividend or both divisor and dividend are decimals, *the quotient contains as many decimal places as the number in the dividend exceeds the number in the divisor.*

NOTES. — 1. If the dividend have fewer decimal places than the divisor, or does not contain the divisor, annex decimal ciphers, according to Art. 202, I.

2. To divide any number by 10, 100, etc., apply Prin. IV., Art. 202, filling the unused places, if any, with ciphers. Thus, 7.8 divided by 1000 equals .078.

230. Exercises. —

1. 23.36÷4
2. $7.50÷$6
3. $8.55÷9
4. $8.69÷$.11
5. 84÷.05
6. 72÷3.6
7. 157 5÷.35
8. $9.50÷150
9. 30 lb. of tea cost $11.70; find the price per lb.
10. 5.5 yd. make 1 rod; how many rods in 7480 yd.?
11. 16.5 ft. make 1 rod, how many rods in 4950 ft.?
12. Paid $183.75 for 35 books; find the price of each.
13. How many sheep, at $3.65 each, will $95 buy?

231. 1. How many books at $.45 each, will $9 buy?

2. At $\$.87\frac{1}{2}$ per bu., how much barley sold for $42?

3. 12.5 tons of hay cost $71.25; find the price per ton.

4. $15\frac{1}{4}$ lb. of butter cost $2.44; find the price per lb.

5. Two men bought a farm for $4200; one man took 70 acres at $35 per acre, the other the remainder at $25 per acre; how many acres were there in all?

6. $\$55.80 \div 72$
7. $\$97.50 \div \$1.75$
8. $12. \div .075$
9. $84 \div .1875$
10. $\$69.25 \div \$.15$
11. $\$37\frac{1}{8} \div \$.125$

232. 1. Having $5, how many 35-cent books can you buy?

2. 147.5 yd. of muslin cost $\$18\frac{2}{5}$; find the price per yd.

3. How many hats, at $1.25 each, cost $65?

4. 6 bbl. of sugar, at $\$.07\frac{1}{2}$ per lb., cost $128.25; how many pounds in each barrel?

5. $8.468 \div .0293$
6. $\$13.395 \div 141$
7. $28.7 \div 100$
8. $18\frac{23}{75} + 27\frac{5}{9}$
9. $\$157\frac{1}{2} \div \$.90$
10. $53\frac{7}{19} - 28\frac{9}{11}$

233. 1. $\frac{1}{2}$ of the value of a farm is $7850; what is .625 of its value?

2. 64 boxes of cheese, averaging $21\frac{1}{2}$ lb. each, cost $180; what was the price per pound?

3. The product of two numbers is $81; one of the numbers is $13.50; what is the other?

4. Add 789, 3957, 6829, 4708, 983, 729, and 596.

5. $\$85.60 \div 49.5$
6. $(7\frac{1}{2} \div 5\frac{2}{3}) \times 2\frac{3}{8}$
7. $70 \div 9.376$
8. $.158710 \div .46$
9. $4.3 \div 9$
10. $7.8 \div .14$

234. 1. How many barrels in 2205 gallons?

2. Change .032 to a common fraction.

3. Change $\frac{17}{28}$ to a decimal.

4. Multiply $837\frac{5}{6}$ by 8.

5. What cost 23 gross of pencils at $.45 per doz.?

6. Multiply $\$53\frac{4}{5}$ by 9. Make a problem.

7. Divide $\$723\frac{5}{6}$ by 8. Make a problem.

8. $8748 \div 1.08$
9. $\$68.40 \div \$.09$
10. $77\frac{3}{14} + 92\frac{5}{11}$
11. $\$47.50 \div 19$
12. $9\frac{5}{8} \div 5\frac{7}{10}$
13. $53\frac{2}{5} \times 7\frac{1}{3}$

14. $3\frac{2}{9}$ are what part of $7\frac{5}{8}$?

15. $38\frac{9}{17} - 9\frac{11}{12} = ?$

16. One half of $12\frac{3}{5}$ is what part of $37\frac{4}{5}$?

17. Add 7859, 987, 9368, 7495, 948, 787 and 969.

V. BILLS AND ACCOUNTS.

235. A Bill is a written statement of goods sold or of services rendered. A bill is '*receipted*' when '*Received Payment*' is written at the bottom with the name of the person to whom the amount is due, signed by himself or his agent.

236. An Account is a written statement of the debts and credits between two parties.

A party owing another is a *Debtor;* a party to whom another owes is a *Creditor.*

A *Statement* is a bill of the items of an account.

Statements are commonly made out and presented monthly.

237. Exercises. — Copy the following bills neatly, find the cost of the several articles, and the amounts. (S. 20.)

1. PITTSFIELD, MASS., *May 5, 1888.*

MR. WILLIS WRIGHT,

Bought of JOHN C. MAJOR & CO.,

16 *lb. Coffee* @ 18¢,
35 *lb. Sugar* @ 11¢,
15 *bu.* potatoes @ 37½¢,
3 *Sacks flour* @ $2.70,

Amt. $

2. ST. PAUL, MINN., *June 7, 1888.*

MRS. SARAH SMITH,

Bought of S. J. JONES,

17 *yd. Muslin*, @ 9¢,	
1 *pr. Shoes*,	$5.80
1 *Boy's Suit*,	$13.60
½ doz. Hose, @ $3.20	
	$

Rec'd payment,

S. J. Jones.

238. 1. How much may I save in 7 months, if my income is $60 per mo., and my expenses $38.25 per mo.?

2. In how many days may a man pay a debt of $96.25, if he earns $3.50 per day?

3. How many pecks of plums cost $15, at $1.50 per bu.?

4. St. Louis, Mo., *June, 7, 1886.*

Warren Brown & Co.,

To S. C. Davis & Co. *Dr.*

June 1,	*To Balance*	*$185.40*
" *7,*	" *158 yd. Worsted, @ $1.45,*	
	" *139* " Flannel, @ *48¢,*	
	" *3 doz. A. 1. Shirts, @ $18.50,*	
	" *$1\frac{1}{2}$* " *Mackinaws, @ $22.60,*	
	" *16* " *Scotch $\frac{1}{2}$ Hose, @ $2.80,*	
	Amount,	

239. 1. John H. Brown bought of Wilson & Meyers, May 3, 1888, 4 lb. coffee at 22¢; 5 lb. tea at 45¢; 11 lb. sugar $1. May 5, 3 cans peaches at 20¢, 12 cans tomatoes at 35¢. May 17, 2 bu. potatoes at $1.35; 1 box raisins, 25 lb., at 15¢. May 25, Brown pays Wilson & Meyers $12. How much was due June 1?

2. I bought a load of coal weighing 4860 lb., at 11 cents a bushel of 80 lb.; how much did the load cost?

3. A man bought a suit of clothes for $23.75, a hat for $5.50, a pair of gloves for $2.10, and a pair of shoes for $8.75; he gave the clerk a 50-dollar bill; how much did he receive in change?

4. How many 8-ounce loaves of bread may be made from a barrel of flour, if four ounces of flour are required for each loaf?

5. Add \$$17\frac{4}{5}$, \$$9\frac{3}{8}$, \$$15\frac{2}{5}$, \$$17\frac{3}{4}$ and \$$29\frac{7}{8}$.

6. At \$.0$6\frac{1}{4}$ each, how many pencils cost $2.75?

7. Divide $74.65 by $1.25. Make a problem.

8. Write 20¢, $1.37, 56¢, and $4.35 in a *line* and add them.

9. Find the L. C. M. of 12, 15, 18 and 21.

10. Define divisor; multiple; similar fractions.

240. 1. Complete the following statement of acct. —

SPARTA, WIS., *June 30, 1886.*

Mr. James Watson,

In account with JOHN ALLEN & Co., *Dr.*

June	1, To	2 bu. Potatoes @ 90c	
“	3, “	1 sack 4 X Flour	2.20
	“	12 lb. C Sugar, @ 10c	
	“	3 lb. Rio Coffee, @ 28c	
“	12, “	1 Boy's Suit,	8.50
	“	1 Pr. Shoes,	4.60
“	17, “	1 Pr. Gloves,	1.50
“	23, “	1 Hat,	2.75
	“	7 lb. Rice, @ 8c	
	“	12 yd. Muslin, @ 15c	
		Cr.	
June	9, By	5 Days' Work, @ $2.75	
“	13, “	1 Pr. Shoes returned,	4.60
“	20, “	Cash	10.00
		Balance due	

2. Divide $3.70 among 3 boys, giving A 35 cents more than B, and C 75 cents less than A.

3. John has $1.75 less than Sam, and both have $7.25; how much has each?

4. I spent $7.80, which was $\frac{2}{5}$ of what I had left; how much had I at first?

5. How many acres in a field 70 rods by 40 rods?

6. Bought a farm of 148 acres at $67 per acre; paid down $7850 in cash, and 19 head of cattle at $35 a head; how much remained unpaid?

7. A boy retailed a peck of chestnuts at 5 cents a pint how much did he get for them?

8. 100 acres of land cost $757; what cost 1 acre?

9. What cost 1950 boxes, at $3\frac{1}{3}$ cents each?

10. Change $.07\frac{1}{3}$ to a common fraction. (S. 19.)

241. 1. Mrs. Ella C. Dean bought of Smith & Fowler, — Aug. 9, 10 lb. rice at $7\frac{1}{2}$¢; 1 box cheese, 23 lb., at 18¢; $4\frac{1}{2}$ lb. tea at 60¢; 15 lb. A sugar at 11¢; 3 lb. coffee at 22¢. Make out a receipted bill.

2. What cost 18 gross pencils at $.35 a dozen?

3. Having $6, how many 80-cent books can you buy?

4. $\$3$ are $\frac{15}{47}$ of how much? 5. Multiply $7.80 by 760.

6. $\$4200$ are $\frac{2}{3}$ of the value of a house; what is the value of $\frac{2}{3}$ of the remainder?

7. $3\frac{5}{8}$ times what amount gives $58?

8. Add $127\frac{3}{8}$, $131\frac{7}{12}$, $47\frac{11}{18}$, $69\frac{4}{9}$ and $39\frac{5}{6}$.

9. $6832\frac{5}{9} \div 8 = ?$ 10. $(\$18 - \$5\frac{5}{8}) \times 3\frac{4}{5} = ?$

242. 1. Bruce Bryer bought of W. H. Little, 4 sacks potatoes, 430 lb., at $1\frac{1}{4}$¢; 5 sacks oats, 490 lb., at $1\frac{1}{2}$¢; 25 lb. sugar at $9\frac{1}{2}$¢; 137 lb. bacon at 19¢. Make out a receipted bill.

2. What cost $23\frac{3}{4}$ yd. cassimere at $.75 per yd.?

3. A man's salary is $1575 a year; how much may he save in $2\frac{1}{2}$ years, if his expenses average $49.75 per month?

4. What cost $49\frac{1}{2}$ cords of wood at $4.65 per cord?

5. A house and lot worth $8350 are worth how much more than 59 mules at $95 per head?

6. Multiply $\frac{3}{4}$ of $5\frac{1}{3}$ by $7\frac{3}{5}$. 7. Multiply $738\frac{5}{8}$ by 9.

8. Divide $\$130.62\frac{1}{2}$ by $\$.27\frac{1}{2}$. 9. Find $\frac{5}{8}$ of $\$73.20$.

243. 1. The Merchants Hotel bought of Brown & Smith, July 9, — 4 cases strawberries at $1.75; 5 bbl. potatoes at $2.60; 3 doz. Elgin corn at $1.60; 2 tubs butter, 87 lb., at $.35; $3\frac{1}{2}$ doz. brooms at $3.75. Make out a bill, crediting the hotel with $45 cash.

2. $\$97.50 \div \$1.75 = ?$ Make a problem.

3. Find $\frac{5}{27}$ of $\$63.45$. Make a problem.

4. What cost .75 of a ton of hay at $\$7\frac{1}{2}$ per ton?

5. At $\$.33\frac{1}{3}$ per yd., how many yd. of cloth cost $7.50?

6. Add 857, 956, 493, 9478, 399, 7896 and 879.

7. $\$.78 \times 863 = ?$ Make a problem.

8. Read $5.65 in two ways. What is cancellation?

9. Give the principles of Fractions; of Decimals.

244. Many **Articles** are **sold by the 100, 1000, or Ton.** Questions involving price, number and cost by the 100 (C.), 1000 (M.), or ton (T.) are commonly solved by analysis, — the first step being to find ' how many *hundreds*, *thousands*, or *tons*,' or to find the price of a single thing or pound.

Examples. — 1. What cost 1320 posts at $18 per C.?

ANALYSES. — (1.) 1320=13.2 C. (hundreds); at $18 per C., they cost 13.2 times $18, or ———. (S. 14.)

(2.) At $18 per C., posts are worth 18 cents each; and 1320 posts are worth 1320 times 18 cents, or ———.

2. What cost 6540 ft. of lumber at $27.50 per M.?

ANALYSES. — (1.) 6540 ft.=6.54 M. ft.; at $27.50 per M., the cost is 6.54 times $27.50, or ———.

(2.) At $27.50 per M., the price is ($27.50÷1000=) $.02$\frac{3}{4}$ per ft.; and 6540 ft. cost 6540 times $.02$\frac{3}{4}$, or ——— .

3. What cost 878 lb. of hay at $7.50 per ton? (Art. 255.)

ANALYSES. — (1.) 878 lb. (÷2000=) .439 of a ton; and .439 T. cost .439×$7.50, or ———.

(2.) At $7.50 per ton, the price is ($\frac{1}{2}$ as much, or) $3.75 per 1000 lb., or $.003$\frac{3}{4}$ per lb.; and 878 lb. cost 878×$.003$\frac{3}{4}$, or———.

245. Exercises. — (S. 21.)

1. What cost 1250 fence posts at $22 per 100?
2. What cost 46400 bricks at 7\frac{1}{2}$ per M.?
3. What cost 8560 lb. of hay at $8 per T.?
4. What cost 7386 ft. of lumber at $9 per 100?
5. What cost 86520 ft. of lumber at $19.50 per M.?
6. Find the freight on 5240 lb. Mdse. at $.30 per 100.
7. Find the value of 78565 lb. of iron at $11.70 per T.
8. What cost 96520 pressed bricks at $29.50 per 1000?
9. What cost 288 boxes at $2.50 per 100?
10. What cost 7 hats at $14.40 per dozen?
11. Paid $7.50 for coal at $5 per ton; how many pounds did I purchase?
12. Paid $19.25 for fence pickets at $27.50 per M.; how many did I buy?
13. What cost 75 lb. of sugar at 8$\frac{3}{4}$¢ per lb.?

246. 1. Among how many men may \$112.50 be distributed, giving each \$$6\frac{1}{4}$? Prove.

2. What cost 27500 ft. of lumber at \$15.75 per M.?

3. What cost 13750 laths at \$.$37\frac{1}{2}$ per 100?

4. Having \$241.30, how many 18-dollar watches could you buy?

5. What is the value of 17 bbl. sugar, averaging 268 lb. each, at 9 cents per pound?

6. Find the G. C. D. of 96 and 384. 7. Write .10405 in words.

8. \$34944 are 12 times the cost of 160 acres of land; find the cost per acre. Prove.

9. $(35\times.7)\div200=$? 10. $763.45\times.0302=$?

247. 1. What part of a dollar are $\frac{5}{8}$ of $\frac{2}{3}$ of it?

2. What cost 2986 ft. of lumber at \$22.25 per M.?

3. $11\frac{1}{2}$ acres of land cost \$735.25; find the price per acre.

4. Paid \$7.80 for coal at \$6 a ton; how much was bought?

5. Find the freight on 5876 lb. of Mdse. at \$.57 per 100?

6. What cost 73 bags of plaster, 255 lb. each, at \$13 per T.?

7. \$63.36÷\$.$13\frac{1}{5}=$? 8. $45.3\div30.2=$?

9. $90\frac{4}{11}\div4\frac{8}{9}=$? 10. $528\frac{1}{2}\div9\frac{1}{3}=$?

248. 1. What cost 47550 bricks at \$8.25 per M.?

2. A printer is paid \$.45 pr. M. *ems;* what will he receive for setting a book of 238 pages of 1130 *ems* each?

3. A dealer sold 7350 cedar posts for \$931; what was the price per 100? Prove.

4. I sell envelopes at 10 cents per package of 25, gaining 3 cents per package; find the cost qer M.

5. What cost 16975 bricks at \$7.90 per M.?

6. 350 pine apples cost \$$26\frac{1}{4}$; find the cost per 100.

7. Divide 105.70 by 3.5. 8. Divide \$687.50 by \$$\frac{1}{2}$.

9. \$$17\frac{1}{5}$ are $\frac{2}{7}$ of what? 10. $59\frac{5}{12}-48\frac{25}{33}=$?

249. 1. Find the L. C. M. of 12, 15, 20 and 56. (S. 30.)

2. What cost .75 of a ton of coal at $\frac{1}{2}$¢ a pound?

3. 2.5 times what amount equals \$56.50?

4. How many rails, at \$3 per 100, cost \$8.70?

5. Divide \$33 by $4\frac{1}{2}$ cents. 6. Multiply \$$2.06\frac{1}{4}$ by 76.

7. Find $\frac{7}{12}$ of \$186.30. 8. \$5.90 are $\frac{4}{7}$ of what?

DENOMINATE NUMBERS.

I. DEFINITIONS, TABLES AND REDUCTIONS.

250. A Denominate Number is a concrete number denoting a weight or measure; as, 7 *lb.*, 2 *yd.*, $2½.

251. A Simple Number is one whose units are all of the same kind or denomination, — it may be either concrete or abstract; as, $3, 8 *ft.*, 9 *lb.*, 15.

252. A Compound Number is one composed of two or more simple numbers taken together; as, 3 *ft.* 5 *in.*, 5 *lb.* 7 *oz.*, 2 *gal.* 1 *qt.* 1 *pt.*

253. In Simple Numbers or Integers, ten ones or units of any order or denomination always equal one unit of the next higher order. (Art. 18.)

In Compound Numbers, the number of units of one order or denomination which equals one unit of the next higher order or denomination varies; as, 2 *pints* = 1 *quart*, 4 *quarts* = 1 *gallon;* 12 *inches* = 1 *foot*, 3 *feet* = 1 *yard*, etc.

The number of units of one order which equals one of the next higher order, may be learned from the *Tables of Weights and Measures.* By means of these tables, denominate numbers may be changed or reduced from one denomination to another of the same kind.

254. The Weights and Measures in common use are: *Avoirdupois Weight*, *Troy Weight*, *Apothecaries' Weight*, *Dry Measure*, *Liquid Measure*, *Linear Measure*, *Square Measure*, *Cubic Measure*, *Circular Measure*, *Time*, and *Counting.*

II. TABLES, AND REDUCTIONS.

255. Avoirdupois Weight is used in weighing all heavy and common articles; as, *grain*, *coal*, *groceries*, *etc.*

TABLE.

16 ounces (oz.) = 1 pound (lb.),
2000 pounds = 1 Ton (T.).

NOTES.—1. The Custom House, or Long Ton, Table, used in estimating duties, and in weighing coal and iron at the mines, is:

112 pounds = 1 hundred-weight (cwt.),
2240 pounds = 1 ton.

2. The avoirdupois pound contains 7000 grains Troy (Art. 257).

256. Exercises.—

1. How many oz. in 5 lb.? in 15 lb.? in 38 lb.?
2. How many lb. in 60 oz.? in 213 oz.? in 7 tons?
3. Change 29 lb. to oz. 4. Change 1000 oz. to lb.
5. Change 129 lb. 9 oz. to ounces.

ANALYSIS.—
In 1 pound there are 16 ounces, in 129 pounds and 9 ounces there are 129 times 16 oz., plus 9 oz., or 2073 oz.

(See Prin. III., Art. 47.)

OPERATION.—

```
129 lb. 9 oz.
 16.
----
 783
129
----
2073 oz.
```

6. Reduce 37582 oz. to higher orders.

ANALYSIS.—There are 16 oz. in 1 lb., and in 37582 oz., there are $\frac{1}{16}$ as many lb., or 2348 lb. 14 oz.; there are 2000 lb. in 1 ton, and in 2348 lb., there are $\frac{1}{2000}$ as many tons, or 1 T. 348 lb.

OPERATION.—

```
  16)37582 oz.
2000)2348 lb. 14 oz.
      1 T. 348 lb.
1 T. 348 lb. 14 oz.
```

7. Reduce 3 T. 179 lb. 8 oz. to ounces.
8. What part of a pound are 8 oz.? 4 oz.? 12 oz.?
9. What cost 7 lb. 12 oz. of cheese at $.20 per lb.?
10. What cost 1 lb. 9 oz. of cinnamon at $.15 per oz.?
11. What cost 8 lb. 8 oz. of steak at 15 cents per lb.?
12. How many oz. in 3 sacks of flour? (See Art. 284.)
13. How many tons of coal in a load of 6756 lb.?

257. Troy Weight is used in weighing gold, silver, and jewels.

TABLE.

24 grains (*gr.*) =1 pennyweight (*pwt.*),
20 pennyweights =1 ounce (*oz.*),
12 ounces (5760 gr.)=1 *pound* (*lb.*).

NOTES.—1. In weighing precious stones, a unit called the *carat* (=3.2 Tr. gr.) is used. 2. The term '*carats fine*' is used to indicate the purity of gold, and means so many *twenty-fourths;* thus, gold 18 *carats fine* is 18 parts pure gold and 6 parts alloy or cheaper metal.

258. Exercises.—

1. How many gr. in 3 pwt.? in 16 pwt.? in 4 lb.?
2. How many pwt. in 96 gr.? in 160 gr.? in 920 gr.?
3. How many oz. in 90 pwt.? in 250 pwt.? in 19 lb.?
4. What part of a Troy pound are 9 oz.? 10 oz.?
5. Change 3 lb. 7 oz. 15 pwt. to grains.
6. Reduce 13579 gr. to higher orders.
7. What cost a watch case, weighing 68 pwt., at $.95 a pwt.?

259. Apothecaries' Weight is used prescribing and mixing dry medicines.

TABLE.

20 grains *gr.*=1 scruple (℈),
3 scruples =1 dram (ʒ),
8 drams =1 ounce (℥),
12 ounces =1 *pound* (℔.).

NOTES.—1. In writing prescriptions, physicians use Roman numerals in small letters following the symbols, writing *j* for *i* when it comes last; thus, 3 *gr.* is written *gr.* iij. ℞ is the symbol for *recipe, take; a* or *aa* means *of each; ss* means *half,*—as *gr.* iiss means *two and a half grains; P.* means *a small part; P. eq.* means *equal parts; q. v.* means *as you please.*

2. Drugs are sold at wholesale by avoirdupois wt.

260. Exercises.—

1. How many drams in 5 ℥ 3 ʒ? in 137 gr.?
2. Change 1385 *gr.* to higher orders.
3. Reduce 1 ℔. 5 ℥ 2 ℈ to grains.
4. How many pills, *gr.* iiiss each, will 2 ℥ of quinine make?
5. Change 9 ℔. 3 oz. ap. to avoirdupois wt.

261. Dry Measure is used in measuring all dry articles; as, *grain*, *fruit*, *etc.* (S. 2.)

TABLE.

2 pints (*pt.*) = 1 quart (*qt.*),
8 quarts = 1 peck (*pk.*),
4 pecks = 1 bushel (*bu.*).

NOTES.—1. A bushel contains 2150.42 cu. in. A Dry Gallon is half a peck, and contains 268.8 cu. in.

2. Grains are generally sold by the bushel *by weight*. In the Western States and Territories, grains and vegetables are commonly sold by the 100 lb.

262. Exercises.—

1. How many pt. in 9 qt.? in $2\frac{1}{2}$ pk.?

2. How many pk. in 4 bu.? in 27 qt.? in 100 pt.?

3. Reduce $7\frac{1}{2}$ bu. to qt. 4. Change 270 pt. to bu.

5. Reduce 4 bu. 3 pk. 2 pt. to pt.

6. Reduce 2005 pt. to a compound number.

7. How much is a load of oats, weighing 1328 lb., worth at \$.35 per bu., if they weigh 32 lb. to the bushel?

8. A coal dealer sold 4360 lb. of coal at $\$.09\frac{1}{2}$ per bushel of 80 lb.; how much did he get for it?

9. A grocer sold a barrel of flour for \$7.25, 17 lb. of sugar at 11 cents, $2\frac{1}{2}$ lb. of tea at 60 cents, and 3 bu. of potatoes at \$1.25. Make out a bill for the amount.

10. $(\$2\frac{3}{4}\times7\frac{4}{5})+\$19\frac{5}{8}=?$ Make a problem.

263. 1. Change 9 bu. 3 qt. 1 pt. to pt.

2. In 4139 pt. how many bu., pk., qt. and pt.?

3. At 15 cents a quart, how much will a fruit seller get for $2\frac{1}{2}$ bu. of cherries?

4. At \$1.20 a bushel, what part of a bu. of plums cost \$.75?

5. A newsboy bought $3\frac{1}{2}$ bu. of chestnuts at \$.45 a peck, and sold them at \$.10 a quart; find his profit.

6. $\$7\frac{1}{2}\times3\frac{5}{6}$ are how much less than $\$37\frac{5}{8}$?

7. A merchant exchanged 63 bbl. of flour at \$5.75 per bbl., for 295 bu. of wheat at \$1.85 per bu., paying the difference in cash; how much money was required?

8. $375\frac{5}{8}\div32=?$ 9. $13\frac{1}{3}\div1\frac{1}{12}=?$

10. What cost $2\frac{1}{8}$ yd. of cloth at \$3.75 per yd.?

264. Liquid Measure is used in measuring liquids.

TABLE.

4 gills (*gi.*) = 1 pint (*pt.*),
2 pints = 1 quart (*qt.*),
4 quarts = 1 gallon (*gal.*).

NOTES.—1. The liquid gallon contains 231 cu. in.

2. The *barrel*, 31½ gal., and the *hogshead* (hhd.), 63 gal., are measures frequently mentioned. In commerce, they are vessels of varying capacity.

265. Exercises. —

1. How many pt. in a gal.? in 27 gi.?

2. How many gi. in 7 qt.? in 2½ gal.?

3. Reduce 46 gi. to qt. 4. Reduce 19 gal. to pt.

5. Reduce 312 gi. to gal. 6. Change 1 bbl. to gi.

7. Reduce 13 gal. 3 qt. 1 pt. to pt.

8. What cost 6380 ft. of lumber at $27.50 pr. M.?

9. A farmer sold 4 loads of hay weighing 1785 lb., 1938 lb., 2016 lb. and 2165 respectively, at $15 per ton; what was the amount of the sale?

10. At $8.50 per 100, how many ft. of lumber cost $336.26?

266. 1. How many pints in 2 casks, one containing 37½ gal., the other 28 gal. 3 qt.?

2. A grocer sold a barrel of vinegar of 32 gal., which cost $8.64, for 10 cents a quart; find his profit.

3. A milkman buys milk at $.15 a gallon, and sells it at 6 cents a quart; find his gain on 37 gal. 3 qt.

4. How many gallons in a cistern containing 240 bbl., when it is three fourths full?

5. If 5 quart bottles are filled from a gallon of wine, how many bottles may be filled from a cask of 36½ gal.?

6. What cost 1680 lb. of plaster, if 2000 lb. cost $3.75?

7. Mrs. S. Mason buys of Aaron Allen: May 1,—27 lb. sugar at $.11; 3 lb. tea at $.45; 2½ lb. coffee at $.22; 10 lb. rice at $.07; 6 lb. raisins at $.15. Make out a receipted bill.

8. 54 horses cost $4650; find the average price.

9. What cost 97½ cords of wood at $3.85 per cord?

10. Define compound number; factor; prime number.

267. Long or Linear Measure is used in measuring lines and distances. (S. 2 and 10.)

A *line* is that which has length only.

TABLE.

12 inches (*in.*) =1 foot (*ft.*),
3 feet =1 yard (*yd.*),
5½ yards, or 16½ feet, =1 rod (*rd.*),
320 rods, or 5280 feet, =1 mile (*mi.*).

NOTES.—1. In measuring cloth, etc., the *yard*, separated into *halves*, *quarters*, *eighths* and *sixteenths*, is used.

2. Surveyors, in measuring land, use a (Gunter's) chain 4 rods long, containing 100 links:

7.92 inches=1 link (*li.*),
100 links =1 chain (*ch.*),
80 chains =1 mile.

3. Civil engineers use a chain or line 100 ft. long, separated into decimal parts.

268. Exercises.—

1. How many in. in 7 ft.? in 10 ft.? in 25 ft.?
2. How many ft. in 9 yd.? in 3 rd.? in 2 rd. 7 ft.?
3. How many yd. in 4 rd.? in 7 rd.? in 180 ft.?
4. How many ft. in 200 in.? 5. Change 3 mi. to ft.
6. Reduce 3½ yd. to in. 7. Change 7 mi. to yd.
8. Reduce 9 rd. 5 yd. to ft. 9. Change 819 ft. to rd.
10. Reduce 2 mi. 270 rd. to yd.

269. 1. How many feet long must a line be to reach around this room? how many yards long? (S. 10.)

2. How many links in a rod? how many inches?

3. A civil engineer's chain is how many rods long?

4. At $3.50 per rod, how much will it cost to build a fence around a field 12 rd. long and 10 rd. wide?

5. How many rods in 72.4 mi.? how many yards?

6. How many common tons in 320 'long' tons?

7. What cost 9 lb. 12 oz. of butter at 18 cents per lb.?

8. What cost a ditch ¾ mi. long at $1.15 per rod?

9. What part of a mile are 120 rods?

10. How many inches in a chain? how many yards?

11. Change .42$\frac{6}{7}$ to a common fraction. Find its cube.

270. Square Measure is used in measuring areas of surfaces.

A Surface has two *dimensions* — *length* and *breadth*. Its *area* is the number of square inches, square feet, etc., contained within the lines which bound it.

A Rectangle is a surface bounded by four straight lines and having four right angles (Art. 299).

A Square is a rectangle whose sides are equal.

The area of a rectangle is said to equal the product of its two dimensions.

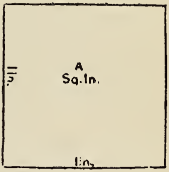


TABLE.

144 square inches (*sq. in.*)	=1 square foot (*sq. ft.*),
9 square feet	=1 square yard (*sq. yd.*),
$30\frac{1}{4}$ square yards	=1 square rod (*sq. rd.*),
160 square rods	=1 acre (*A.*),
640 acres	=1 square mile (*sq. mi.*) or section.

NOTES. — 1. In surveying land, 16 *sq. rd.*=1 *square chain*, 10 *sq. ch.*=1 *A.* The square rod is sometimes called a *perch* or *pole*.

2. In measuring work in roofing, flooring, etc., 100 *sq. ft.*=1 *square*.

271. Exercises. — (S. 10.)

1. How many sq. ft. in 7 sq. yd.? in 15 sq. yd.?
2. How many sq. rd. in 2 acres? in 5 acres?
3. How many sq. ft. in 288 sq. in.? in 2 yd. square?
4. Reduce 8680 sq. in. to sq. ft.; 2 sq. rd. to sq. ft.
5. How many sq. ft. in a floor 10 ft. by 15 ft.?
6. How many sq. yd. in a floor 17 ft. by 21 ft.?
7. How many acres in a field 25 rd. by 16 rd.?

272. 1. How many sq. yd. in the floor of this room?

2. The distance from Washington to Baltimore is 41.5 miles; how many rods? how many feet?

3. How many sq. rd. in $9\frac{5}{8}$ acres?

4. At what price per bu. will $28\frac{3}{4}$ bu. of corn cost $17.25?

5. A lot 7.5 rd. by 20 rd. is what part of an acre?

6. Add 18.85, 76.0875, 29.5086, 19.7, and 128.078.

7. Change $\frac{56}{125}$ to a decimal. 8. Find $\frac{5}{8}$ of 3 acres.

9. How many rods around a field $\frac{1}{2}$ mi. square?

273. Cubic Measure is used in measuring contents or volumes of solids. (S. 2 and 10.)

A Solid has three *dimensions* — *length*, *breadth* and *thickness*. Its *contents* or *volume* is the number of cubic feet, cubic yards, etc., contained in it.

A Rectangular Solid is one bounded by six rectangles.

A Cube is a rectangular solid whose sides or faces are equal squares.

The contents or volume of a rectangular solid is said to equal the product of its three dimensions.

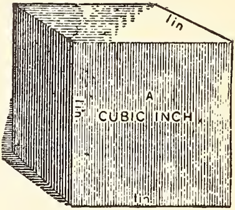


TABLE.

1728 cubic inches (*cu. in.*) = 1 cubic foot (*cu. ft.*),
27 cubic feet = 1 cubic yard (*cu. yd.*).

NOTES. — 1. A pile of wood 8 ft. long, 4 ft. wide, and 4 ft. high, or 128 *cu. ft.*, equals 1 *cord* (*cd.*).

2. 24.75 cu. ft. are called a perch; but, in masonry, the perch varies in different localities, being 25 cu. ft., 22 cu. ft., or 16.5 cu. ft.

274. Exercises. —

1. *Show* that there are 27 cu. ft. in a cu. yd.

2. How many cu. yd. in 960 cu. ft.?

3. How many cu. ft. in 12480 cu. in.?

4. How many cu. ft. in a block 15 in. long, 14 in. wide, and 13 in. thick?

5. How many cu. ft. in a stone 7 ft. by 4 ft. by $2\frac{1}{2}$ ft.?

6. How many cu. ft. of space in this room? cu. yd.?

7. How many sq. ft. in the ceiling of this room? in the sides and ends? in all? How many sq. yd.?

8. What will it cost to plaster the walls and ceiling of a room 15 ft. by 12 ft., 10 ft. high, at $.35 per sq. yd., making no allowance for doors and windows?

9. What cost 970 lb. of hay at $9 per ton?

10. Add $17\frac{5}{8}$, $29\frac{5}{6}$, $14\frac{3}{5}$, $9\frac{9}{16}$ and $27\frac{7}{12}$.

11. How many cords of wood in a pile 40 ft. by 4 ft. by 4 ft.?

275. Money or Currency is a circulating medium of exchange.

United States (or Federal) Money is the currency of the United States. See Art. 207–209.

English (or Sterling) Money is the currency of Great Britain.

TABLE.

4 farthings (*far.*) = 1 penny (*d.*),
12 pence = 1 shilling (*s.*),
20 shillings = 1 pound (£).

NOTES. — 1. The gold coin representing the pound is the *Sovereign;* the *Guinea* is a gold coin worth 21*s.;* the *Crown* is a silver coin worth 5*s.*

2. The pound is nominally worth $4.8665 in U. S. Money.

3. The denominations in *Canada Money* are the same as in U. S. Money, and the coins are nominally of the same value.

276. The *Franc*, in **French Money,** is worth $.193 in U. S. Money.

The *Mark*, in **German Money,** is worth $.243 in U. S. Money; nominally 4 marks equal $1 of U. S. Money.

277. Exercises. —

1. How many shillings in 90d.? in £4?
2. How many pounds in 40s.? in 110s.?
3. About how much is a crown worth in U. S. Money?
4. How many shillings in 15 guineas?
5. Change £19 15s. to U. S. Money.
6. Reduce $597 to English Money; to German Money.
7. A field of 84 sq. rd. is 14 rd. long; how wide is it?
8. What is the value of a pile of wood 70 ft. long, 6 ft. high, and 4 ft. wide, at $5 per cord?

278. 1. What is the difference between a 4-inch square and 4 square inches?

2. What cost 3 quarts of sirup at $.90 per gal.?
3. Change 65792 oz. to pounds and tons.
4. What cost 19580 lb. of coal at $7.50 per ton?
5. 31800 bricks, at $6.25 per M., cost how much?
6. What cost $7\frac{1}{4}$ yd. of cloth at $4.60 per yd.?
7. How many rods in 750 yards?
8. How many lb. of hay, at $12.50 per T., cost $8.50?

279. Time is the measure of duration as marked by days and years.

TABLE.

60 seconds (*sec.*) = 1 minute (*min.*),
60 minutes = 1 hour (*hr.*),
24 hours = 1 day (*da.*),
365 days = 1 common year (*yr.*),
366 days = 1 leap year,
100 years = 1 century.

NOTES.—1. The year is also divided into 12 months; in the Calendar, April, June, September and November have 30 days each; February 28 days in common years and 29 days in leap years; the others have 31 days each.

2. In business transactions, 30 days make a month.

3. The solar year is nearly 365.25 days in length,—the fraction in 4 years amounts to *nearly* a day, and a day is, therefore, added to February in all leap years except those ending in 00.

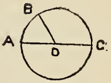
280. Exercises.—

1. How many sec. in 3 min.? in 60 min.?
2. How many min. in 3 hr.? in $\frac{1}{2}$ day? in 2400 sec.?
3. How many da. in 128 hr.? 4. Change 9 da. to sec.
5. How many hours in the month of May?
6. Find from a calendar how many days from Washington's Birthday to the Fourth of July.
7. A Troy lb. is how much less than an avoirdupois lb.?
8. How many cords of wood in a pile 60 ft. × 8 ft. × 4 ft.?

281. 1. How many months in 7.5 years? in .675 yr.?
2. Change 76592 in. to higher orders.
3. How many sq. ft. in a sq. rd.? cu. ft. in a cu. rd.?
4. What cost 27563 ft. of lumber at $\$28$ per M.?
5. Change 73 bu. 5 qt. to pt. 6. Divide 7.6 by .305.
7. Divide $\$5.16\frac{2}{3}$ by $\$.08\frac{1}{3}$. 8. $(8\frac{5}{9}+9\frac{3}{16})\times 1\frac{2}{3}=$?
9. Divide $\$798\frac{5}{8}$ by 6. Make a problem.
10. $\$2560$ are $\frac{2}{7}$ of A's money; how much has he?
11. $\$56$ are $\frac{4}{5}$ of five times how much?
12. Give the table for Troy wt.; for long measure.
13. In $\frac{2}{3}$ of $\frac{4}{5}=$? why multiply the denominators together?
14. How do common fractions and decimals differ?
15. How many acres in a field $\frac{3}{4}$ mi. square?

282. Circular or Angular Measure is used in measuring angles and arcs, latitude and longitude. (S. 24.)

A Circle is a plane figure bounded by a curved line, called a **Circumference**, all points of which are equally distant from a point within called the *Centre*. (S. 10.)



Every circumference is made up of 360 equal parts called *degrees*. Any part of a circumference is an *Arc*.

In the figure above, A B C is the circumference of the circle, D is the centre, and A B and B C are arcs.

An Angle is the difference in direction of two lines which meet; it is measured by the arc of any circumference included between its sides.

The figure shows an angle of 45 degrees.

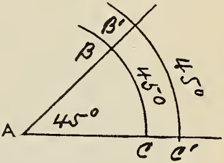


TABLE.

60 seconds (60″) = 1 minute (1′),
60 minutes = 1 degree (1°),
360 degrees = 1 circumference (*cir.*).

NOTES. — 1. The measure of a right angle, ¼ cir., is a *Quadrant*; ⅙ cir. is called a *Sextant*.

2. A degree on the Earth's equator is about 69.16 statute miles. Degrees of *longitude* are measured by shorter arcs on parallels near the poles, but a degree of *latitude* is somewhat longer near the poles than at the equator.

A *minute* of arc corresponds to a geographic or nautical mile, or knot.

283. Exercises.—

1. Change 25° 30′ to minutes of arc.
2. Change 47° 14′ 24″ to seconds of arc.
3. Change 1 quadrant and 15° to minutes of arc.
4. What part of a yard are 2 ft. 6 in.?
5. Bought a hat in Paris for 25 francs; what was its value in U. S. Money?
6. A miller sold 7690 lb. of flour at $3.25 per C.; what was the amount of the sale?
7. What cost 17 bales of cotton, 460 lb. each, at $.09½ per lb.?
8. Divide .065 by .026. 9. Divide $155 by $.0625.
10. What cost 12500 shingles at $4.75 per M.?

284. Miscellaneous Table. —

12 things = 1 dozen (*doz.*),
12 dozen = 1 gross (*gro.*),
20 things = 1 score,
24 sheets of paper = 1 quire,
20 quires = 1 ream,
4 inches = 1 hand,
22 inches = 1 sacred cubit,
6 feet = 1 fathom,
120 fathoms = 1 cable-length,
1.15 statute mi. = 1 geographic or nautical mile,
3 miles = 1 league,
49 lb. of flour = 1 sack,
196 lb. of flour = 1 barrel.

285. Exercises. —

1. How many dozen in 250 boxes? in 900?
2. How many feet and inches in $15\frac{1}{2}$ hands?
3. A man is how old at 'three score and ten'?
4. A dozen is what part of a score?
5. Sold $2\frac{1}{4}$ gro. buttons at $.15 a dozen; find the amount.
6. A ship sails 176 leagues; how many miles?
7. How many tons will 225 bbl. of flour weigh?
8. How many cu. in. in $31\frac{1}{2}$ gallons?
9. A 20-acre lot is 40 rods wide; how long is it?
10. How many liquid gallons equal 7 bushels?

286. 1. How many seconds in the month of July?

2. If you save $.05 a day how much will you save in 2 yr. 3 mo. 28 da.?

3. Reduce 3 mi. 576 ft. to yd. 4. Change $1\frac{1}{2}$ A. to sq. yd.

5. Add $27\frac{5}{9}$, $39\frac{5}{8}$, $36\frac{11}{20}$. 6. $(\$5\frac{1}{4}\times7\frac{2}{3})+\$28\frac{4}{5}=?$

7. How many bu. of potatoes, at $.20 per pk., cost $7.60?

8. How many dozen in 56 score?

9. What number multiplied by 297 gives 39273? *Prove.*

10. Reduce 86400 seconds to hours.

11. The time from 1801 to 1900 inclusive is the "Nineteenth Century"; how many years yet remain of it to pass?

12. Describe the process in addition of fractions.

III. ADDITION AND SUBTRACTION.

287. In Addition and Subtraction of Denominate Numbers, the process is similar to that in Integers, being modified as required by the varying unit values (Art. 253).

Examples. — 1. Add 1 yd. 2 ft. 11 in., 2 ft. 9 in., 2 yd. 1 ft. 8 in.

ANALYSIS. — 8 in.+9 in.+11 in.=28 in., or 2 ft. 4 in.; 2 ft.+1 ft.+2 ft.+2 ft.=7 ft., or 2 yd. 1 ft.; 2 yd.+2 yd.+1 yd.=5 yd. (The numbers might be reduced to inches, added, and the sum reduced to ft., etc.)

OPERATION. —

1 yd.	2 ft.	11 in.
	2 "	9 "
2 "	1 "	8 "
5 yd.	1 ft.	4 in.

2. From 3 mi. 220 rd. 4 yd. take 1 mi. 64 rd. 5 yd.

ANALYSIS. — 5 yd. being greater than 4 yd., change 1 rd. to $5\frac{1}{2}$ yd. and add them to 4 yd., making $9\frac{1}{2}$ yd.; then $9\frac{1}{2}$ yd.—5 yd.=$4\frac{1}{2}$ yd., or 4 yd. 1 ft. 6 in.; 219 rd.—64 rd.=155 rd.; etc.

OPERATION. —

3 mi.	220 rd.	4 yd.
1 "	64 "	5 "
2 mi.	155 rd.	$4\frac{1}{2}$ yd.

288. Exercises. —

1. Add 3 hr. 29 min. 7 sec., 5 hr. 38 min., and 1 hr. 7 min. 56 sec.

2. Add 1 lb. 7 oz. 13 pwt., 9 oz. 7 pwt., 1 lb. 18 pwt., 7 oz. 4 pwt., and 2 lb. 4 oz. 14 pwt.

3. Add 53° 16′ 24″ and 13° 29′ 58″.

4. Add $\frac{7}{15}$ of a day and 14 hr. $17\frac{2}{3}$ min.

5. Add 7 lb. 9 oz., 15 lb. 14 oz., 12 lb. 7 oz. and 9 lb. 8 oz.

6. From 75° 19′ 24″ take 71° 28′ 11″.

7. From 7 hr. 39 min. take 3 hr. 24 min. 20 sec.

289. 1. What time elapsed between May 13, 1885, and July 22, 1887?

2. A was born June 22, 1847; how old is he to-day?

3. How long since the Declaration of Independence?

4. Find the time from Feb. 9 to Nov. 6 of this year.

5. A note dated May 20, 1883, was paid Aug. 14, 1887; how long did it run?

6. From 147 A. 57 sq. rd. take $78\frac{5}{16}$ acres.

7. $\$7\frac{1}{2} \div \frac{2}{3}$ ct.=? 8. Multiply $725\frac{4}{5}$ by $6\frac{2}{5}$.

9. What cost $5\frac{3}{4}$ T. of lead at $5.25 per 100 lb.?

290. 1. How many sq. ft. in 7394 sq. in.?

2. What cost 2 lb. 7 oz. 15 pwt. of silver at $.95 per oz.?

3. How many hours in $\frac{5}{8}$ of a year?

4. 3 hr. 40 min. are what part of a day?

5. Find the difference between a Troy lb. and an Avoirdupois lb.

6. What cost 15625 ft. of lumber at $22.50 per M.?

7. How many books at $1.25 each cost $48.75?

8. At $6\frac{1}{4}$ cents each, how many cups cost $16?

9. 18 men do a piece of work in 12 days; how many days should it take 30 men?

10. 17\frac{1}{2}$ buy $8\frac{3}{4}$ yd. of cloth; what will $22\frac{3}{4}$ yd. cost?

291. 1. If 6 men build 40 rods of wall in $4\frac{1}{2}$ days, how many rods will 8 men build in 5 days?

2. At 1\frac{7}{10}$ per day, what will 9 men earn in 3 weeks?

3. A sold a farm for $6750 which was $\frac{5}{7}$ of the cost; how much did he lose?

4. B sold a house and lot for $57, gaining $\frac{1}{4}$ as much as it cost, how much did he gain?

5. At 7\frac{1}{5}$ a ton how much coal cost $10?

6. At $1.60 a rod, what cost a ditch $1\frac{3}{4}$ mi. long?

7. Divide the sum of $9\frac{3}{5}$ and $7\frac{5}{8}$ by $\frac{7}{12}$.

8. How many cu. in. in a barrel? (Art. 264.)

9. Sold $17\frac{1}{8}$ tons of hay at 9\frac{3}{5}$ per ton; find the amount.

10. Give the table for cubic measure; for Troy wt.

292. 1. In a school $\frac{2}{4}\frac{1}{3}$ of the pupils are boys; what part of the school are girls?

2. A room is $17\frac{1}{2}$ ft. long and $15\frac{5}{6}$ ft. wide; how far is it around the room? how many sq. ft. in its area?

3. I pay $275 on a debt of $500; what part of the debt remains unpaid?

4. At 2\frac{1}{4}$ a ton, how much coal will 50 cents buy?

5. Change 8356 Troy grains to higher orders.

6. $7\frac{1}{2}$ feet are what part of a rod?

7. How many links in a rod?

8. 5\frac{3}{5}$ are $\frac{4}{9}$ of what? 9. Divide 314.16 by .7854.

10. What part of $3\frac{3}{4}$ bushels are 1 bu. 4 qt.?

IV. MULTIPLICATION AND DIVISION.

293. In Multiplication and Division of Denominate Numbers, the process is similar to that in Integers, being modified as required by the varying unit values (Art. 253).

Examples. — 1. Multiply 3 oz. 7 pwt. 5 gr. by 8.

ANALYSIS. — 8×5 gr.=40 gr., or 1 pwt. 16 gr.; 8×7 pwt., +1 pwt., = 57 pwt., or 2 oz. 17 pwt.; 8×3 oz.,+2 oz.,=26 oz., or 2 lb. 2 oz.

OPERATION. —

$$\begin{array}{r} 3\text{ oz. } 7\text{ pwt. } 5\text{ gr.} \\ 8 \\ \hline 2\text{ lb. } 2\text{ oz. } 17\text{ pwt. } 16\text{ gr.} \end{array}$$

2. Find one ninth of 21℔. 5℥ 5ʒ.

ANALYSIS. — 1 ninth of 18℔.=2℔.; 3℔.+5℥=41℥, and 1 ninth of 36℥=4℥; 5℥+5ʒ=4ʒ, and 1 ninth of 45ʒ=5ʒ.

OPERATION. —

$$\begin{array}{r} 9\underline{)21℔.\ 5℥\ 5ʒ} \\ 2℔.\ 4℥\ 5ʒ \end{array}$$

(In this and the preceding example, the compound numbers might be reduced to the lowest order, then multiplied or divided as in Integers.)

3. Divide 5 lb. 3 oz. Troy by 2 oz. 4 pwt.

NOTE. — Reduce both numbers to pwt., then divide as in Integers.

294. Exercises. —

1. 7 bu. 3 pk. 4 qt.×7.
2. 4 oz. 9 pwt. 7 gr.×12.
3. 7 hr. 3 min. 26 sec.×15.
4. 8 lb. 6 pwt.÷9.
5. 5ʒ 2℈ 7 *gr.*÷16.
6. 78° 24′ 20″÷15.

7. Find the weight of 1 dozen forks, each weighing 15 pwt. 10 gr.

8. How many spoons, each weighing 2 oz. 5 pwt. may be made from 7½ lb. of silver?

295. 1. Find 1 eighth of 78 mi. 222 rd.

2. Divide ⅝ T. by 7 lb. 8 oz. 3. 76 rd. 9½ ft.×4=?

4. How many feet high is a horse 15½ hands high?

5. A watch gains ½ min. every two hours; how much will it gain in the month of October?

6. A bicycle wheel, 15 ft. 6 in. in circumference, will revolve how many times in going 1½ miles?

7. What cost 9 lb. 14 oz. butter at 50 per lb.?

8. How many weeks in 7 years 115 days?

296. 1. What part of a bushel are 2½ pecks?

2. A boy spent ⅗ of his money and had $8.20 left; how much did he spend?

3. A grocer pays $7.12½ per bbl. for flour, and sells it at $8.75; how much does he gain on 29 bbl.?

4. How many sq. ft. in 2½ sq. rd.?

5. A man born Nov. 19, 1831, died Sept. 12, 1887; how many years did he live?

6. Find the freight on 13590 lb. of iron at $.35 per 100.

7. Divide $87.50 by $.70. 8. Multiply $5.65 by 7¾.

9. Multiply 5681 by 7800. 10. Divide 5681 by 3200.

297. 1. How many feet in 276 rods? how many yd.?

2. Change .16⅔ to a common fraction.

3. A merchant paid $56 for 35 yd. of cloth, and sold it at $2.15 a yard; how much was his profit?

4. The smaller of two numbers is 78⅔, their difference 96⅝; what is the larger number?

5. At $.37½ per bu., how many bu. of corn cost $75?

6. A laborer earns $1.90 a day, and his expenses are $7.75 a week; how much may he save in 23 weeks?

7. What cost 156½ cords of wood at $5.75 per cd.?

8. How many sheets of paper in 12 reams?

9. Divide $5.50×36 by $.45. 10. ($12.60÷$.09)×37½.

298. 1. What cost 128 reams of paper, 32 lb. per ream, at $.22 per pound?

2. Divide $125 by $.12½. 3. Multiply $7.33⅓ by 18.

4. At $.87½ per yd., how many yd. of carpet cost $175?

5. How many miles in 22480 feet?

6. What is the value of ¾ of a bbl. of flour at 5 cents per lb.?

7. How many lengths of fence, each 12 ft., make 60 rd.?

8. How many bottles, each holding ⅘ qt., may be filled from a cask of wine containing 42½ gal.?

9. What will 18 yd. 2 ft. of iron railing cost at $1.10 per ft.?

10. From 7½ lb. of silver 3 lb. 5 oz. 10 pwt. were sold; how much was left?

11. How do you divide one compound number by another?

MEASUREMENTS.

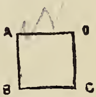
I. SURFACES.

299. A Surface is that which has *length* and *breadth.*

The common regular surfaces are the *Square, Rectangle, Triangle* and *Circle.*

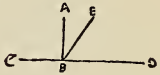
A Square is a figure having four equal sides and four right-angles.

The figure A B C D is a square.

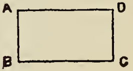


When one straight line meets another so as to make the adjacent angles equal, either angle is a **Right-Angle.**

In the figure A B C and A B D are right-angles.



A Rectangle is any figure bounded by four straight lines and having four right-angles; as, A B C D.



Figures bounded by straight lines are called *Polygons.*

300. *The area of a rectangle is the product of the number of square units in one dimension by 'as many' as there are in the other.*

301. Exercises. — (S. 10.)

1. How many square feet in a floor 9 ft. by 12 ft.?

Analysis. — Were the floor 12 ft. long and 1 ft. wide, its area would be 12 sq. ft.; but the floor is 12 ft. long and 9 ft. wide, its area is, therefore, 9 times 12 sq. ft., or 108 sq. ft.

Note. — In practice we say: "The area of a floor 9 ft. by 12 ft. is 9×12 sq. ft., or 108 sq. ft." Do not say: "feet multiplied by feet give square feet." (Art. 47, I.)

2. How many sq. yd. in a floor 18 ft. by 25 ft.?

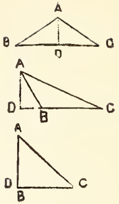
3. How long is a floor 12 ft. wide, containing 240 sq. ft.?

4. How wide is a floor 15 ft. long, containing 20 sq. yd.?

5. How many acres in a field 60 rd. by 80 rd.?

6. What does it cost to paint a floor 16 ft. by 21 ft. at $.30 per sq. yd.?

7. How many bricks, 8 in. by 4 in., in a walk 4 ft. by 66 ft.?



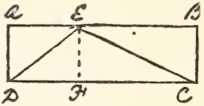
302. A Triangle is a plane figure bounded by three straight lines and having three angles.

The *Base* of a triangle is the line on which it is supposed to stand. B C is the base in each of the given triangles.

The *Altitude* of a triangle is the shortest distance from the base (or base extended) to the opposite angle. A D is the altitude in each of the given triangles.

A Right-angled Triangle is one having one right-angle.

The *Hypotenuse* of a right-angled triangle is the side opposite the right-angle. The *Perpendicular* is the line joining the hypotenuse and base.



303. *The area of a triangle equals one half of the area of a rectangle having an equal base and altitude.*

304. Exercises. —

1. What is the area of a triangle whose altitude is 7 in. and base 10 in.? ($\frac{1}{2}$ of 7×10 sq. in.) (S. 10.)

2. How many sq. rd. in a triangular field, the base 67 rd. and the altitude 36 rd.? how many acres?

3. The area of a triangle is 12 sq. ft.; the base is 6 ft.; what is the altitude? ($12 \times 2, \div 6$.)

4. How many long tons in 224 common tons?

5. $13\frac{1}{2}$ hours are what part of a day?

6. Change £1560 to U. S. Money.

305. 1. A bought a farm 176 rd. by 64 rd. at $67.50 per acre; he built a fence around it costing $1.75 a rod, then sold it for $8500; find his gain.

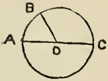
2. Change 7 rd. $2\frac{1}{2}$ ft. to in. 3. $7.60 are $\frac{5}{6}$ of what?

4. Find the area of a triangle; base $2\frac{1}{2}$ yd., altitude 9 ft.

5. How much coal at $5 per ton will cost $7.80?

6. Find the altitude of a triangle; area 9 sq. yd., base 18 ft.

7. $\frac{2}{3}$ of a peck are what part of a bushel?



306. **A Circle** is a plane figure bounded by a curved line, called the *Circumference*, all points of which are equally distant from a point within called the *Centre.*

The Diameter of a circle is a straight line passing through the centre and terminated by the circumference; as, A C. The *Radius* is a straight line joining the centre and the circumference; as, A D or B D.

307. *The circumference of a circle is 3.1416 (about $3\frac{1}{7}$) times the diameter.*

The diameter of a circle is .3183 (nearly $\frac{7}{22}$) of the circumference.

The area of a circle is .7854 of the square of the diameter.

NOTE.—In making rough estimates, we say the circumference is about three times the diameter, the diameter is about one third of the circumference, and the area is about four fifths of the square of the diameter.

308. Exercises. —

1. Find the circumference of a circle 9 ft. in diameter.

2. Find the diameter of a circular reservoir 157.08 yd. in circumference. Find the radius; the area.

3. Find the area of a circle 20 yd. in diameter.

4. How far will a wheel $3\frac{3}{4}$ ft. in diameter travel in making 560 revolutions?

5. What cost 9850 laths at 20 cents per 100?

6. What is the area of a room 25 ft. by $7\frac{1}{2}$ yd.?

309. 1. How many revolutions will a carriage wheel 3 ft. in diameter make in going 2 miles?

2. A horse tied by a rope allowing him to reach 66 ft. from a post, can graze over how many sq. yd.?

3. How many bricks $4\frac{1}{2}$ in. by 9 in., will pave a court-yard 36 ft. by 48 ft.?

4. Change $7836 to Eng. Money.

5. $\$27 \div \$.37\frac{1}{2} = ?$

6. Divide $573\frac{2}{3}$ by $7\frac{1}{2}$.

7. $\$87 - \$49.53 = ?$

8. $5\frac{2}{3}$ lb. of silver will make how many 2-oz. spoons?

9. A has $7560, B $\frac{7}{8}$ as much; how much have both?

310. 1. What will it cost to carpet a room $15\frac{1}{2}$ ft. by 19 ft. with carpet $\frac{3}{4}$ yd. wide, at $1.10 per yd., if the breadths must run across the room, and be 6 in. longer than the width of the room that the figures may match?

SOLUTION. — $19\frac{1}{2}$ ft.$=6\frac{1}{2}$ yd.; $6\frac{1}{2}$ yd.$\div\frac{3}{4}$ yd.$=8\frac{2}{3}$,—9 *full breadths are required;* $15\frac{1}{2}$ ft.$+\frac{1}{2}$ ft.$=16$ ft., or $5\frac{1}{3}$ yd.; 9 times $5\frac{1}{3}$ yd.$=48$ yd.; and 48 yd. at $1.10=etc. (S. 23.)

2. What will it cost to carpet a room 20 ft. by 17 ft., with carpet $\frac{3}{4}$ yd. wide, at $1.50 per yd., if the breaths run lengthwise and are $\frac{1}{4}$ yd. longer than the room?

3. How many acres in a street $1\frac{1}{4}$ mi. long, 4 rd. wide?

4. What cost 132450 bricks at $8.50 per M.?

5. What will it cost to paint a ceiling 15 ft. by 20 ft. at 30 cents per square yard?

311. 1. What will it cost to carpet a room 14 ft. by 17 ft. with carpet $\frac{3}{4}$ yd. wide, at $.90 per yd., the breadths running crosswise and turned under 1 foot?

2. What will it cost to plaster the walls and ceiling of a room 15 ft. by 18 ft., 12 ft. high, at $.40 per sq. yd., making no allowance for doors and windows?

3. A 12-acre field is 60 rd. long; how wide is it?

4. A slate roof 58 ft. by 24 ft. will cost how much at $8.50 per square? (See Art. 270, Note 2.)

5. A man died May 9, 1888, aged 47 yr. 3 mo. 27 da.; find the date of his birth.

312. 1. Reduce 26358 sq. in. to sq. ft. and sq. yd.

3. Make out a receipted bill for the following:

John Brown bought of Geo. Smith: 25 lb. sugar at $.09; $2\frac{1}{2}$ lb. tea at $.40; 1 box raisins, 24 lb., at $.18; 1 bbl. salt $3.80; 20 gal. coal oil at $.28; and 2 sacks flour at $2.15.

3. A stone wall around a lot 10 rd. long and 8 rd. wide, will cost how much at $5.80 per yd.?

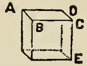
4. What will it cost to cover a floor 16 ft. by 21 ft. with linoleum at $.95 per sq. yd.?

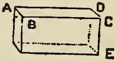
5. What cost 3460 lb. of coal at $.12 per bu. of 80 lb.?

6. Define triangle; rectangle; circle; quadrant.

II. SOLIDS.

313. A Solid is that which has three dimensions — *length*, *breadth* and *thickness*.





The common regular solids are the *Cube*, *Rectangular Solid*, and *Sphere*.

A Cube is a solid bounded by six equal squares.

A Rectangular Solid is any solid bounded by rectangles.

314. *The volume or contents of a rectangular solid equals the product of the cubic units in one dimension multiplied by 'as many' as the product of the other two.*

315. Exercises. —

1. How many cu. ft. in a stone 5 ft. by 3 ft. by 2 ft.?

ANALYSIS. — Were the stone 5 ft. long, 1 ft. wide and 1 ft. thick, it would contain 5 cu. ft.; were 5 ft. long, 3 ft. wide and 1 ft. thick, it would contain 3×5 cu. ft.; but the stone is 5 ft. long, 3 ft. wide and 2 ft. thick, it contains, therefore, 2×3×5 cu. ft., etc.

NOTE. — Do not say: "square feet multiplied by feet give cubic feet."

2. How many cu. ft. in a piece of timber 36 ft. long, $1\frac{1}{4}$ ft., wide and $\frac{3}{4}$ ft. thick?

3. How many cu. ft. in a room 17 ft. by 14 ft., and 12 ft. high? how many cu. yd.?

4. How many sq. ft. in the surface of a cu. yd.?

5. What will it cost to plaster a room of the same size as this room, at $.38 per sq. yd.?

316. 1. How many cords of wood in a pile 78 ft. long, 4 ft. wide and 8 ft. high?

2. How many cu. yd. of earth were taken from an excavation 27 ft. by 24 ft., 7 ft. deep?

3. What will it cost to excavate a cellar 112 ft. by 24 ft., $6\frac{1}{2}$ ft. deep, at $.45 per cu. yd.?

4. If 1 inch of rain fall, how many gallons will a cistern receive from a roof 24 ft. by 35 ft..

5. How many cubic feet in a cubic rod?

317. Lumber and Timber are sold by the *thousand* (*M.*) *Board Feet.*

A Board Foot *equals a square foot of board 1 inch thick.*

A cubic foot equals 12 board feet, hence cubic feet may be changed to board feet by multiplying by 12.

Boards less than an inch thick are counted one inch thick, otherwise the thickness is as measured.

318. *The number of board feet in a piece of lumber equals the product of the number of feet (or parts of a foot) in width, multiplied by the number of inches in thickness, multiplied by the number of feet in length.*

319. Exercises.—

1. How many board feet in a plank 10 in. wide, $2\frac{1}{2}$ in. thick, and 18 ft. long? ($\frac{5}{6}$ ft. $\times 2\frac{1}{2} \times 18 = ?$) (S. 10.)

2. How many feet in a board 14 ft. long, 15 in. wide, and $\frac{3}{4}$ in. thick? ($1\frac{1}{4}$ ft. $\times 1 \times 14 = ?$)

3. How many feet of lumber in 256 boards 8 in. wide $1\frac{1}{2}$ in. thick, and 12 ft. long?

4. How many ft. of lumber are required to build a fence 5 boards high, around a field 28 rd. by 42 rd., the boards being 14 ft. long, 1 in. thick and 6 in. wide?

5. How much will the above fence cost, a post being required for every 7 feet of fence, the posts costing $.22 each. and the lumber $18 per M.?

320. 1. How many feet of lumber in your desk?

2. How many feet of lumber in a wagon-box $9\frac{1}{2}$ ft. long, $3\frac{1}{2}$ ft. wide, and 15 in. deep?

3. How many feet of flooring, $1\frac{1}{2}$ in. thick, will be required for a floor 18 ft. by 20 ft., allowing $\frac{1}{5}$ for waste and matching?

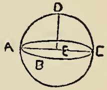
4. What will it cost to carpet the above floor with carpet 1 yd. wide, at $1.15 per yd., the strips running crosswise and allowing 12 in. for turning under?

5. How many feet in 3 mi. 147 rd. 12 ft.?

6. If 17 are $1\frac{2}{3}$ times some number, what are $\frac{5}{8}$ of it?

7. Find the area of a triangle, base 90 ft., altitude 65 ft.

321. **A Sphere** is a solid bounded by curved surface all points of which are equally distant from a point within called the centre.



A Diameter of a sphere is a straight line passing through the centre and terminated by the surface; as, A C.

A Radius of a sphere is half its diameter.

322. *The surface of a sphere equals 3.1416 (about $3\frac{1}{7}$) times the square of its diameter.*

The volume or contents of a sphere is .5236 (about $\frac{1}{2}$) of the cube of its diameter.

323. Exercises. —

1. Find the surface of a sphere 12 in. in diameter.

2. Find the volume of a sphere 16 in. in diameter.

3. Find the diameter of a tree 22 ft. in circumference.

4. What is the cost of 136 scantling, 16 ft. long, 3 in. by 4 in., at $25 per M.?

5. A field 64 rd. long contains 16 acres; how wide is it?

324. 1. What is the surface of a 12-in. globe?

2. What is the cost of a carpet for a room 15 ft. by 19 ft. at $1.15 per yd., the strips running lengthwise, and turned under $1\frac{1}{4}$ ft.?

3. A box is $3\frac{1}{2}$ ft. by 2 ft., $1\frac{1}{3}$ ft. deep; how many sq. ft. in its surface?

4. What cost $16\frac{3}{4}$ yd. of cloth at $1.25 per yd.?

5. Divide $58\frac{2}{3}$ by $7\frac{5}{6}$. 6. Divide $63.36 by $.13$\frac{1}{5}$.

325. 1. What is the surface of a cube 36 in. long?

2. A has a square field 12 rd. long; B has one 4 times as large; how long is it?

3. How much will it cost to gild a ball 2 ft. in diameter, at 3 cents per sq. in.?

4. The large wheel of a bicycle is 54 in. in diameter; how many revolutions will it make in going 3 mi.?

5. How many steps, each 2 ft. 6 in., do I take in walking 5 miles?

6. How many minutes of arc in a sextant? (Art. 282.)

326. 1. How many bricks are required to build a wall 20 ft. long, 12 ft. high and 20 in. thick?

NOTE.—In estimating the number of bricks required for a wall, it is sufficiently accurate to count 20 bricks to the cu. ft.

2. How many bricks will be required for the outside walls of a house 32 ft. long, 22 ft. wide, 16 in. thick, and 19 ft. high above the foundation? Cost, at $9.75 per M.?

SOLUTION.—$(32+32+22+22)\times1\frac{1}{3}\times19\times20\times\$.009\frac{3}{4}=?$

NOTE.—The length of the walls is counted on the outside, generally making no allowance for openings.

3. How many bu. of wheat in a bin 12 ft. by 9 ft., 5 ft. deep?

SOLUTION.—$(12\times9\times5)\div\frac{5}{4}=?$ ($\frac{5}{4}$ cu. ft.=1 bu., nearly.)

4. A school room 24 ft. by 29 ft., 14 ft. high will allow how many cu. ft. of air to each of 50 pupils?

5. How many ft. of lumber in 480 boards 12 ft. by 11 in., 1 in. thick; 156 joists 22 ft. by 16 in., 2 in. thick; 236 scantling 16 ft. by 2 in. by 4 in.? Cost, at $24 per M.?

6. Six 40-gallon casks will hold how many bushels?

327. 1. A cistern 8 ft. deep and 5 ft. square at the top and bottom, will hold how many gallons?

2. What cost 28 walnut boards 14 ft. long, 18 in. wide, and 1 in. thick, at $90 per M.?

3. What is the value of a pile of wood 72 ft. by 6 ft. by 4 ft., at $4.50 per cord?

4. How many board feet in a piece of timber 22 ft. long, 13 in. wide and $10\frac{1}{2}$ in. thick?

5. How many tiles 6 in. square will cover an area 32 ft. by 24 ft.? Find the cost at $.45 per sq. yd.

328. 1. Mr. John's house cost $8750, which was twice the cost of the lot; find the cost of both.

2. I paid out $39.60, which were $\frac{3}{5}$ as much as I had left; how much had I at first?

3. $56\frac{8}{9}$ are $3\frac{5}{8}$ times what? 4. Change 26 bbl. to pt.

5. What cost 3 bu. 3 pk. of apples at $.80 per bu.?

6. Find the L. C. M. of 30, 42, 66 and 70.

7. Find the altitude of a triangle, base 64 rd., area 10 A.

329. 1. What is the value of a pile of wood 57 ft. by 7 ft. by 8 ft., at $4.12½ per cord?

2. Find the diameter of a circle 57.5 yd. in circumference.

3. Find the area of a triangle, base 27 in., altitude 2 ft.

4. How many acres in a field 48 rd. by 60 rd.?

5. What cost 27 hats at $73.50 per dozen?

6. An arc of 75° is what part of a circumference?

7. What cost 180 2-in. planks, 22 ft. long, 14 in. wide at $18 per M.?

8. How many strips of carpet ¾ yd. wide will be required for a room 22 ft. wide?

330. 1. How many 4-inch squares in a 2-foot square?

2. How many revolutions will a 5-foot wheel make in going 17 miles?

3. What cost 18 lb. 12 oz. of butter at $.45 per lb.?

4. A board 16 in. wide, contains 12 sq. ft.; how wide is it?

5. What cost 18¾ bu. of corn at $.75 per bu.?

6. 12½ acres of land cost $193¾; what cost 2⅗ acres?

7. What part of the day is gone at 2:30 P. M.?

331. 1. How many cu. ft. of granite in a block 9 ft. long, 4½ ft. wide and 2¾ ft. thick?

2. What part of a rod are 2 ft. 9 in.?

3. What cost 1475 lb. of flour at $3.25 per 100?

4. What cost 1638 fence pickets at $45 per M.?

5. Paid $167.50 for a car load of lumber at $35.75 per M.; how many feet did it contain?

6. How many acres in a field 60 rd. wide, ½ mi. long?

7. What part of a square yard of cloth is a strip 27 in. long and 15 in. wide?

332. 1. 10 lb. avoirdupois equal how many Troy lb.?

2. How many liquid gallons equal a bushel?

3. What is the time from May 19, to November 12?

4. Divide 5⅔ ft. by 2¼ in. 5. Divide 3 rd. by ⅗ yd.

6. What cost 15¾ yd. of silk at $2.25 per yd.?

7. In the month of May, James Brown worked for Mr. Thos. Wright 17 days at $2.25 per day. Make out a bill.

333. 1. What is the weight of 2 dozen silver forks, each weighing 3 oz. 18 pwt.?

2. What will it cost to excavate a cellar 48 ft. by 28 ft., $8\frac{1}{2}$ ft. deep, at $\$.47\frac{1}{2}$ per cu. yd.?

3. An 8-acre field 40 rd. long must be how wide?

4. What will it cost to tint the walls and ceiling of a hall 60 ft. by 38 ft., 16 ft. high, at 5 cents per sq. yd.?

5. How many feet of lumber in 128 joists 16 ft. long, 16 in. by 3 in.? What is the cost at $22.50 per M.?

6. How many bu. will a wagon box $8\frac{1}{2}$ ft. by $3\frac{3}{4}$ ft., 15 in. deep, hold?

7. What cost 7 reams of paper at 22 cents a quire?

334. 1. How many gallons of water will fill a tank 5 ft. by 4 ft. by $3\frac{1}{2}$ ft.?

2. What will it cost to pave a walk 68 ft. long and $5\frac{1}{2}$ ft. wide, at $1.25 per sq. yd.?

3. $\frac{5}{8}$ of 60 are how many times $\frac{2}{3}$ of 10?

4. A can build a wall in 6 days, B in 9 days; how long will it take both working together?

5. In how many days will 12 men do as much work as 15 men in 20 days?

6. What part of $4\frac{2}{3}$ rd. are $7\frac{2}{3}$ ft.?

7. What cost 3970 lb. of hay at $18 per ton?

335. 1. How long a cord will reach around a tree 4 feet 9 inches in diameter?

2. Find the area of a circular pond 100 ft. in diameter.

3. If $\frac{3}{8}$ in. of rain fall, how many gallons will flow into a cistern from a roof 28 ft. by 36 ft.?

4. How many bricks, each $4\frac{1}{2} \times 9 \times 2\frac{1}{2}$ in., in a pile 12 ft. long, 6 ft. high and 4 ft. wide?

5. How many yd. of cambric, $\frac{3}{4}$ yd. wide, will line 18 yd. of cloth one yard wide?

6. 280 geographic mi. equal how many common mi.?

7. Find the volume of a sphere 9 in. in diameter.

8. $(5\frac{2}{5} \times 3\frac{3}{4}) \div 1\frac{7}{8} = ?$ 9. $(\$3\frac{4}{5} \times 7\frac{1}{2}) + (\$9\frac{3}{4} \times 8\frac{1}{3}) = ?$

10. Add $7.87, $9.68, $7.56, $14.59, $8.54 and $4.95.

PERCENTAGE.

I. INTRODUCTION; THE THREE PROBLEMS.

336. From a school of 300 pupils, 5 of every hundred were absent; how many were absent?

One winter a stockman lost 7 *per cent*, or 7 hundredths ($\frac{7}{100}$), of his band of 2500 horses; how many did he lose?

337. 9 *per cent*, or 9 hundredths ($\frac{9}{100}$), of my money equal $18; how much have I?

75 yd. are 5 *per cent*, or 5 hundredths ($\frac{5}{100}$), of how many?

420 are 5 *per cent*, or 5 hundredths, more than how many? or 105 hundredths ($\frac{105}{100}$), of how many?

320 are 20 *per cent*, or 20 hundredths, less than how many? or 80 hundredths ($\frac{80}{100}$), of how many?

338. $15 are how many *per cent*, or how many hundredths, of $300?

48 yd. are how many *per cent*, or how many hundredths, of 200 yd.?

240 lb. are how many *per cent* of 200 lb.?

$280 are how many *per cent* of $70?

339. It is readily seen that the questions in the preceding Articles are simply new forms for the problems:

I. To find one or more of the equal parts of a number (Art. 176).

II. To find a number when one or more of the equal parts of it are given (Art. 184).

III. To find what part one number is of some other number (Art. 184).

Such operations, in which reference is made to *one hundred* as a basis, are called operations in *Percentage*. (S. 3, 4 and 30.)

340. Percentage is a term applied to calculations in which a whole of one hundred equal parts is the unit.

The term *per cent* means *by the hundred;* thus, 7 *per cent* of any quantity means 5 *of every hundred*, or 5 *hundredths* of it.

Per cent may be indicated by a decimal or a common fraction, or by the sign, %; thus, 7 *per cent* of — =.07 of —, or $\frac{7}{100}$ of —, or 7 % of —.

341. The number of which some per cent is found is the **Base.** "*The Base is always 100% of the Base.*"

The *number of hundredths* taken of any number is the **Rate.**

The part of a number, taken as hundredths of it, is the **Percentage.**

The Base plus the Percentage is the **Amount.**

The Base less the Percentage is the **Difference.**

In the expression, 7% 200=14, 200 is the *Base*, 7% the *Rate*, 14 the *Percentage*, 214 the *Amount*, and 186 the *Difference*.

342. A common fraction may be used for the *Rate.* —

$50\% = \frac{1}{2}$
$33\frac{1}{3}\% = \frac{1}{3}$
$66\frac{2}{3}\% = \frac{2}{3}$
$25\% = \frac{1}{4}$
$75\% = \frac{3}{4}$

$20\% = \frac{1}{5}$
$40\% = \frac{2}{5}$
$60\% = \frac{3}{5}$
$80\% = \frac{4}{5}$
$16\frac{2}{3}\% = \frac{1}{6}$

$83\frac{1}{3}\% = \frac{5}{6}$
$12\frac{1}{2}\% = \frac{1}{8}$
$37\frac{1}{2}\% = \frac{3}{8}$
$62\frac{1}{2}\% = \frac{5}{8}$
$87\frac{1}{2}\% = \frac{7}{8}$

$10\% = \frac{1}{10}$
etc.
$8\frac{1}{3}\% = \frac{1}{12}$
etc.
$6\frac{1}{4}\% = \frac{1}{16}$

343. Exercises. — (S. 25.)

1. What is 1% of 500? 5%? 20%? 120%? 80%? $\frac{1}{2}\%$?
2. Find 6% of \$8; 5% of \$120; $12\frac{1}{2}\%$ of 400 rd.
3. \$20 are 5% of what? 20% of what? $\frac{1}{2}\%$ of what?
4. \$3.50 are 50% what? 10% of what? 7% of what?
5. 24 ft. are what % of 200 ft.? of 120 ft.? of 36 ft.?
6. \$.25 are what % of \$1? of \$1.25? of \$.40? of \$.20?

344. 1. \$105 are 5% more than what, or 105% of what?

2. 210 are 5% more than what? 100% more than what?
3. \$2.50 are 25% more than what? $66\frac{2}{3}\%$ more than what?
4. 80 are 20% less than what? 60% less than what?
5. What sum, less 50% of itself, equals \$35?
6. What sum. plus 7% of itself, equals \$321?

345. To Find the Percentage; Exercises. —

1. Find 12% of $320. (S. 25.)

ANALYSIS. — 1% of $320 is $3.20; 12% of $320 are 12 times $3.20, or $38.40 (1 *per cent* of the base is found by changing the decimal point two places to the left, Art. 202, IV.)

OPERATION. —

$$\begin{array}{r} \$320 \\ 3.20 \\ 12 \\ \hline \$38.40 \end{array}$$

2. Find 75% of 476 lb.

ANALYSIS. — 75% of $=\frac{3}{4}$ of; and $\frac{3}{4}$ of 476 lb.$=$357 lb.

(Use cancellation whenever practicable.)

OPERATION. —

$\frac{3}{\cancel{4}}$ of $\overset{119}{\cancel{476}}$ lb.$=$357 lb.

Find —

3. 8% of $150
4. 20% of 250
5. 4% of $750.
6. 25% of 430.
7. 12% of $756.
8. 23% of 516 ft.

9. A man having $1750, paid out 15% of it; how much did he pay out? What % had he left? (S. 25.)

10. B has 780 sheep, C has 25% of as many more than B; how many has C?

346. 1. What is 1% of $440? $\frac{1}{4}$%? $\frac{3}{4}$%? $\frac{5}{8}$%?

2. $7\frac{1}{2}$% of 250?
3. $6\frac{1}{4}$% of 380?
4. $16\frac{2}{3}$% of 603?
5. $87\frac{1}{2}$% of 144?
6. $\frac{3}{5}$% of $750?
7. $\frac{2}{9}$% of 1080?

8. A clerk whose salary was $1080 a year, had it increased 15%, what did he then receive?

9. A man bought a cow for $60, and sold her at a gain of 20% of the cost; find the gain.

10. In a school of 270 pupils, 45% of the number are boys; how many girls are there?

347. 1. Find 8% of $\frac{5}{8}$.

ANALYSIS. — 1% of $\frac{5}{8}=\frac{5}{800}$; 8% of $\frac{5}{8}=8\times\frac{5}{800}$, or —.

2. 37% of 59.
3. 75% of 95.
4. 7.5% of $32\frac{1}{2}$ yd.
5. $6\frac{2}{3}$% of $9.60.
6. $12\frac{1}{2}$% of 54 ft.
7. 112% of $\$57\frac{1}{2}$.

8. Out of 128 words, a class misspelled $12\frac{1}{2}$% of them; how many were missed? spelled correctly?

9. $43\frac{3}{4}$% of a note for $1560 being paid, how much yet remained to be paid?

10. $37\frac{1}{2}$% of 88 are how much less than 19% of 750?

348. 1. Find $\frac{3}{7}$ of 854; find 15% of \$896.

2. A drover bought 785 sheep of A, and 60% as many of B; how many did he buy of both?

3. A farm which cost \$7980, was sold at a profit of 27%; find the selling price.

4. For what must butter which cost 30¢ a pound, be sold to gain 20%?

5. A carriage, bought for \$180, was sold at a loss of $12\frac{1}{2}$%; find the loss and the selling price.

6. What is a farm 180 rd. by 160 rd. worth, at \$$37\frac{1}{2}$ per A.?

7. $5\frac{7}{8}$ is what part of 19? 8. Find 22% of \$$7\frac{1}{2}$.

9. (\$$3\frac{2}{5}$ × 42) ÷ \$1.40 = ? 10. Find $\frac{7}{8}$% of \$920.

349. 1. A's salary of \$75 a month was reduced 15%; what was his salary after the reduction?

2. A clerk earns \$960 a year; his expenses are $62\frac{1}{2}$% of his salary; how much has he left?

3. A pile of wood 40 ft. long and 4 ft. wide contains $7\frac{1}{2}$ cords; how high is it?

4. 6 sheets of tin weigh 9 lb. 6 oz.; find the weight of each.

5. How many rods in $37\frac{1}{2}$% of a mile?

6. How many yards of cloth at \$.$18\frac{3}{4}$ a yard, are worth as much as 16 dozen eggs at \$.15 a dozen?

7. Divide \$$783\frac{4}{5}$ by 8. 8. Multiply \$$483\frac{3}{4}$ by 9.

9. Find 15% of 7 lb. 8 oz. 10. From $58\frac{1}{3}$ take $29\frac{4}{11}$.

350. 1. A commission merchant sold 260 bbl. of flour at \$7.50 per bbl.; find his commission at $2\frac{1}{2}$%.

2. A's farm contains 280 acres, B's farm is 35% larger; how many acres in both farms?

3. The population of a village ten years ago was 4350; it has since increased 22%; find the present population.

4. A merchant sold cloth costing \$3.75 at a loss of $16\frac{2}{3}$%; find the selling price.

5. If I gain $37\frac{1}{2}$% on coal which cost \$7.20 per ton, what is my profit on 185 tons?

6. Change £86 to U. S. Money. 7. Divide $28\frac{5}{9}$ by $7\frac{3}{5}$.

8. Change 10 lb. av. to Troy wt. 9. Multiply $96\frac{2}{5}$ by $9\frac{7}{8}$.

351. To Find the Base; Exercises. —

1. 20 bu. are 5% of how many bushels?

ANALYSIS. — If 20 bu. are 5% of —, 1% of — is 1 fifth of 20 bu., or 4 bu., and 100% of — equals 100 times 4 bu., or 400 bu. (Art. 202, III.)

OPERATION. —
5) 20 bu.
4 bu.
400 bu.

2. \$15 are 20% of how much? (S. 25.)

ANALYSIS. — 20% of $=\frac{1}{5}$ of; then \$15 are 20% of 5 times \$15, or \$75.

3. \$120 are 4% of what?

4. \$50 are 8% of what?

5. \$240 are 15% of what?

6. 700 lb. are 28% of what?

7. \$$72\frac{1}{2}$ are 20% of what?

8. 8.4 gal. are $12\frac{1}{2}$% of what?

9. A man paid 16% of his money for a watch costing \$68; how much had he?

10. A boy earned \$7.50 which was 25% of what he had before; how much has he now?

352. 1. 68 feet are 20% less than how many feet?

ANALYSIS. — If 68 ft. are 20% less than some number, or 80% of it, 1% of the number is 1 eightieth of 68 ft., or .85 ft., and 100% of it equals 100 times .85 ft., or 85 ft. (S. 25.)

OPERATION. —
100%—20%=80%
80) 68.00 (.85, 85 ft.
640
400

2. 954 acres are 6% more than how many?

3. \$37.50 are 25% less than what? more than what?

4. What amount less 11% of itself equals \$275.90?

5. A's money, \$672, is 5% more than B's; how much more has A than B?

6. \$$78\frac{1}{2}$ are 12% less than how much?

353. 1. \$9.75 are $\frac{3}{4}$% of what amount?

ANALYSIS. — $\frac{1}{4}$% of $=\frac{1}{3}$ of \$9.75, or \$3.25; 1% of = 4×\$3.25, etc.

2. \$11.50 are $\frac{2}{3}$% of what?

3. $\frac{4}{9}$ are 12% of what?

4. $\frac{5}{8}$ are $\frac{3}{4}$% of what?

5. $\frac{3}{4}$ ft. are $12\frac{1}{2}$% of what?

6. A farmer sold 420 bu. of oats; this was $37\frac{1}{2}$% of his crop; how many bu. had he left?

7. A company lost 15% of its number in battle, and had 136 men left; how many had it at first?

8. $66\frac{2}{3}$ yd. of cloth cost \$25; what cost $37\frac{3}{4}$ yd.

354. 1. The commission for making a collection at 2% was \$3.40; what was the amount collected?

2. A house valued at \$8000 was insured for $\frac{3}{4}$ of its value at $1\frac{1}{4}$%; find the amount of the premium.

3. A man paid a premium of \$8.55 for insuring a house at $1\frac{1}{2}$%; find the amount of the insurance.

4. Sold a horse for \$150, gaining 20%; find the cost.

5. Sold a watch for \$72, losing 10%; find the cost.

6. How many gross of pencils will supply 3860 pupils one year; if each pupil requires 4 pencils?

7. $(173 - 49\frac{7}{8}) \times 9\frac{11}{12} = ?$ 8. $70 \div 9.376 = ?$

9. Change $\frac{51}{256}$ to a decimal. 10. 47 rd. 4 yd. $\times 4 = ?$

355. 1. What number plus 18% of itself equals 131.54?

2. Find $\frac{3}{4}$% of \$$\frac{5}{6}$. 3. \$.75 are 30% of how much?

4. An agent collected \$854; find his commission at $2\frac{1}{4}$%.

5. Sold a horse for \$145, gaining 16%; find the cost.

6. A grocer sold 82 bbl. of apples at 22% profit and gained \$45.10; what was the cost per bbl.?

7. Sold a carriage for \$240, losing 20%; find the cost.

8. Add $17\frac{5}{8}$, $29\frac{3}{10}$, $56\frac{7}{12}$, $24\frac{23}{30}$ and $37\frac{7}{15}$.

9. Change £918 12s. to U. S. Money.

10. For what is circular measure used? Define angle; arc.

356. 1. \$1532.25 are $12\frac{1}{2}$% less than what number?

2. What sum plus 40% of itself equals \$735?

3. A merchant sold a bill of goods at a profit of 35%, and gained \$122.50; find the cost.

4. \$36.75 were paid for a pile of wood 56 ft. long, 6 ft. high, and 4 ft. wide; find the price per cord.

5. What cost 47 A. 135 sq. rd. of land at \$60 per acre?

6. How many sq. in. in the surface of a cu. yd.?

7. Change \$1186 to sterling money; to German money.

8. How many bu. will a bin 8 ft. $\times$ 10 ft. $\times$ $4\frac{1}{2}$ ft. hold?

9. A and B owned a mill which they sold for \$13200; if A's share was $\frac{3}{5}$ of B's, how much money should each get?

10. $2\frac{3}{4}$ yd. of velvet cost \$9.25; what cost $15\frac{1}{2}$ yd.?

11. What part of \$$13\frac{3}{4}$ are \$$2\frac{1}{2}$?

357. To Find the Rate; Exercises.—

1. $164 are what per cent of $800?

Analysis.—1% of $800 is $8; and $164 are *as many* % of $800, as $8 are contained times in $164, or 20½%.

Operation.—
$800
$$\$8\overline{)\$164}$$
20.5, or 20½%

2. 36 rd. are what % of 144 rd.?

Analysis.—36 rd. are ¼ of 144 rd., and ¼ of = 25% of.

What % of—

3. $600 are $24?
4. 2400 are 84?
5. $75 are $12.50?
6. $60 are $4.50?
7. 2560 are 42?
8. 5900 are 177?

9. A drover having 1850 sheep, sold 740 of them; what % of his flock did he sell?

10. A clerk earns $960 a year; his expenses are $37.50 per month; what % of his salary may he save?

358. 1. What % of $1050 are 12½% of $420?

2. What % of 1¼ are ⅝?

Analysis.—1% of 1¼ is $\frac{5}{400}$; ⅝ are *as many* % of 1¼ as $\frac{5}{400}$ are contained times in ⅝, or ($\frac{5}{8}\times\frac{400}{5}=$)50%.

What % of—

3. $800 are $350?
4. $125 are $4.75?
5. $234 are $28.08?
6. $350 are $400?
7. 24 ft. are 3⅓ ft.?
8. 2¾ bu. are ⅘ bu.?

9. A man's property amounts to $8750; he owes $10500; what % of his debts can he pay?

10. A lot containing 20 sq. rd. is what % of another lot 20 rd. square?

359. What % of—

1. $87 are $2.90?
2. 846 are 141?
3. $1000 are $1250?
4. 4½ mi. are 3⅗ mi.?
5. 8 bu. are 4 qt.?
6. 5⅓ are 3⅕?

7. A paid $17.50 for a saddle, and $87.50 for a horse; the saddle cost what % of the cost of the horse?

8. ¼ of a dime is what % of 4 cents?

9. 11 rd. 5½ ft. are what % of 4 rd. 2 yd.?

10. A horse which cost $84, was sold for $96; what % was gained in the trade?

11. $24 are what % of £10?

12. Find the cube of 7½.

360. 1. A boy bought a pair of skates for \$.80, and sold them for \$1.20; what % did he gain?

2. A class missed 15 words out of 90 in a spelling lesson; what % did they miss?

3. A house valued at \$5600, was insured for 5 years at $2\frac{5}{8}\%$; find the premium or cost of insurance.

4. How shall I mark goods costing \$.75 to gain 20%?

5. How shall I mark goods costing \$2 to gain $37\frac{1}{2}\%$?

6. Make out a receipted bill for the following:

George Brown bought of Smith & Kelly, — June 10, 1886, 1220 ft. of lumber at \$35 per M.; June 20, 1450 ft. of flooring at \$38 per M.; June 30, 1 keg of nails, 100 lb., at $4\frac{1}{2}$ cents. Brown works for Smith & Kelly during the month 17 days at \$2.75 per day. They settle the account July 30.

361. 1. An agent sold a farm for \$3850, at a commission of 5%; what was his commission?

2. What is the gain, and the selling price, of goods that cost \$28.40, and were sold at a profit 30%?

3. $3\frac{1}{2}$ tons of coal cost $\$31\frac{1}{2}$; how much will \$25 buy?

4. Sold $\frac{2}{3}$ of a farm for \$4200; what was the value of $\frac{2}{3}$ of the remainder at the same rate?

5. $\$42\frac{3}{4} \div \$7\frac{3}{5} = ?$ 6. $(.7 \div .35) \div 200 = ?$

7. A merchant sold a bill of goods amounting to \$165, deducting $7\frac{1}{2}\%$ for cash payment; how much did he get for them?

362. 1. I paid \$7.80 for a load of coal at \$5 per ton; how much did it weigh?

2. A pays \$476 for rent; if this amount is 14% of his income, what is his income?

3. What per cent does a grocer make when he sells his goods at $\frac{6}{5}$ of the cost? (S. 26.)

4. What per cent was lost on a carriage which cost \$180, and was sold for \$150?

5. What % is gained on goods costing \$42.50, sold for \$51?

6. What cost 43550 bricks at \$8.75 per M.?

7. What cost 2875 lb. of coal at \$.15 per bu. of 80 lb.?

363. 1. What is the value of 156 boards 16 ft. long, 15 in. wide, $1\frac{1}{2}$ in. thick, at $30 per M.?

2. $20\frac{3}{5}$ tons of coal cost $110.21; what cost $16\frac{1}{2}$ tons?

3. A spent 25% of his money, and then had $828; how much had he at first?

4. $$7\frac{3}{8}$ are $\frac{5}{9}$ of how much? 5. Find $\frac{5}{8}$% of $7\frac{2}{3}$.

6. Sold a watch and chain for $224, gaining 40%; what was the cost? (S. 26.)

7. A pays $6.50 per week for his board, and this is 26% of his salary; what is his salary?

8. A lot 10 rods square is what % of an acre?

364. 1. A ton of hay cost $$24\frac{1}{2}$; what part of a ton would $20.40 buy?

2. Paid for insurance on flour 10 cents per bbl. at $1\frac{1}{4}$% of the valuation; find the valuation.

3 Paid $9.60 for flour; sold it at $10.20; what % was gained?

4. A is worth $9800, B is worth $43\frac{1}{2}$% of as much more; how much are both worth?

5. 31 rd. $5\frac{1}{2}$ ft. are what % of 80 rd. 3 yd.?

6. A cu. ft. is what % of a bushel?

7. A cubical cistern 9 ft. deep, holds how many gallons?

8. A field of 135 A. is 180 rd. long; how wide is it?

365. 1. How many sq. yd. in the walls and ceiling of a room 24 ft. by $22\frac{1}{2}$ ft., 14 ft. high?

2. A merchant falls 15% from the price he asks for goods, and sells for $34; find the price asked.

3. The report of a cannon was heard 10 seconds after the discharge of the gun; if sound travels 1120 ft. per second, how far away was the gun?

4. Sold a horse for $171, gaining 14%; find the cost.

5. Sold A's farm for $8540; sent him the proceeds after taking out my commission at 4%; what did he get? (S. 26.)

6. Selling price $11.60; loss $6\frac{1}{4}$%; find the cost.

7. $3\frac{1}{7}$ are what per cent of $\frac{5}{8}$ of 44?

8. What is the surface of a cube 32 in. long?

9. Find the volume of a 2-foot sphere; the surface.

366. 1. At what price must I mark goods that cost $\$\frac{5}{8}$ per yard, to gain 40% ?

2. What is $187\frac{1}{2}\%$ of \$75? 3. Write .2068 in words.

4. What number increased by $3\frac{1}{3}$ of itself gives 930?

5. I buy paper at \$2.40 per ream; at what price must I sell it per quire to gain $66\frac{2}{3}\%$?

6. What will it cost to paint both sides of a close board fence 7 rd. long, 5 ft. high, at \$.18 per sq. yd.?

7. Find $\frac{1}{18}$ of 12 cu. yd. 144 cu. in.

8. At \$75 per acre, what cost a field 178 rd. by 128 rd.?

9. What part of $7\frac{3}{11}$ are $4\frac{19}{24}$? 10. Divide $7358\frac{7}{9}$ by 9.

367. 1. How many revolutions will a carriage wheel $3\frac{1}{2}$ ft. in diameter make in going $3\frac{1}{2}$ miles?

2. Find the time from May 19, '88 to Nov. 12, '89.

3. Find the L. C. M. of 4, 5, 6, 7, 8, 9 and 10.

4. $\frac{2}{5}$ of a flagstaff were broken off by the wind, leaving 60 ft. standing; how much was broken off?

5. I invest \$8400 and gain $17\frac{1}{2}\%$; what was my gain?

6. Sold a bill of goods for \$545, giving a discount of 5% for cash; how much did I get?

7. Sold a hat for $\$6\frac{1}{2}$, losing $16\frac{2}{3}\%$; find the cost.

8. An agent sold a house and lot receiving $\$27\frac{1}{2}$ commission at $2\frac{1}{2}\%$; find the selling price.

9. $\frac{3}{8}$ of $6 \div \frac{5}{6}$ of $\frac{3}{4} = ?$ 10. $\$256\frac{5}{8} \times 72 = ?$

368. 1. What will it cost to build a fence around a 20-acre lot 80 rods long, at \$1.80 a rod?

2. A load of wood 6 ft. long $4\frac{1}{2}$ ft. high and 4 ft. wide, is worth how much at \$4.50 per cord?

3. A and B rent a pasture together for \$7.50; A puts in 4 cows, B puts in 6; how much should each pay?

4. \$36.90 are 12% of what? 5. What % of $7\frac{1}{2}$ are $3\frac{3}{5}$?

6. What cost 15 lb. 10 oz. of butter at \$.30 per lb.?

7. If $11\frac{1}{2}$ A. of land cost \$724.50, 240 sq. rd. cost how much?

8. $4\frac{4}{5}$ are $7\frac{1}{2}\%$ of what? 9. $13\frac{1}{5} \div .0304 = ?$

10. $\frac{3}{4}$ yd. of velvet cost $\$4\frac{1}{2}$; \$15 will buy how much?

11. \$224.70 are 7% more than how much?

369. 1. A farmer sold 618 bu. of wheat, which was $37\frac{1}{2}\%$ of his crop; how much had he left?

2. Sold a horse for \$300, gaining $12\frac{1}{2}\%$; find the cost.

3. Sold a horse costing \$300 for \$261; what % was lost?

4. A merchant falls 20% from the price asked for goods, and sells for \$16.20; find the price asked.

5. Find the commission at $2\frac{1}{4}\%$ on a sale for \$3720.

6. Find the proceeds of a sale for \$716, at 4% com'n.

7. A skipper paid \$35 for insurance on his boat at $1\frac{1}{4}\%$; find the valuation of the boat.

370. 1. Add $79\frac{5}{9}$, $28\frac{7}{12}$, $37\frac{15}{16}$ and $84\frac{11}{15}$.

2. A is assessed a tax of \$.017 per dollar on his property valued at \$9500; find the amount of his tax.

3. A black board 4 ft. wide around a room 25 ft. by 30 ft., will cost how much at $\$.37\frac{1}{2}$ per sq. yd.?

4. A car 32 feet long, $8\frac{3}{4}$ feet wide is filled with wheat to the depth of $2\frac{1}{2}$ ft.; how many bushels in the load?

5. If iron ore is 72% pure, how much iron in 9 tons of ore?

6. The cost is \$500; the com'n $\$12\frac{1}{2}$; find the rate.

7. $\frac{7}{8}$ yd. are $18\frac{3}{4}\%$ of what? 8. Find $1\frac{2}{3}\%$ of \$17.70.

371. 1. How far will a 54-inch bicycle carry its rider in making 180 revolutions?

2. A can build a fence in 9 days, A and B together in 5 days; how long should it take B alone?

3. B bought 216 bbl. of flour for me at \$7.25 per bbl., charging me 3% for buying; find the whole cost.

4. Find $7\frac{1}{2}\%$ of $\frac{15}{16}$. 5. $\$63\frac{3}{5}$ are $5\frac{3}{10}\%$ of what?

6. The whole cost is \$364.42 at 3% com.; find the cost.

7. Find the proceeds of a sale for \$8.40; at 5% com.

372. 1. Smith handed me \$150 saying, "This is 30% of what I owe you;" how much does he still owe me?

2. A is 48 years old, and 25% of his age equal 20% of B's age; B is how much older than A?

3. Sold goods for $\$32\frac{1}{5}$, gaining 15%; find the cost.

4. Find $\frac{5}{8}\%$ of $\$856\frac{3}{4}$. 5. $\$22\frac{1}{2}$ are $\frac{2}{3}\%$ of what?

6. A cu. ft. is what % of a bushel?

373. 1. C can build a wall in 9 days alone, B and C in 6 days; how long should it take C alone?

2. $\$4\frac{1}{2}$ equal $\frac{3}{4}$ of the cost of a barrel of flour; how much would $\$1\frac{3}{4}$ buy at the same rate?

3. What sum plus 40% of itself equals $74.50?

4. Find the proceeds of a collection, when the commission at 2% is $16.40.

5. $4\frac{4}{5}$ are $7\frac{1}{2}\%$ of what number? 50% less than what?

6. What was the cost of sawing a pile of wood 28 ft. long, 6 ft. high and 4 ft. wide, at $1.20 per cord?

7. Change 7 lb. 8 oz. Troy to avoirdupois wt.

374. 1. Bought flour at $9.20 per bbl., and sold it at $12.20; what per cent was gained?

2. A can build a fence in 12 days alone, A and B together in 8 days; how long should it take B alone?

3. 40 rd. $2\frac{1}{2}$ yd. are what % of half a mile?

4. $1575 are $16\frac{2}{3}\%$ more than what amount?

5. 13 hr. 36 min. are what part of a day?

6. $(13\frac{1}{2}+7\frac{5}{12})\div5\frac{4}{7}=?$ 7. $(22\frac{5}{9}-7\frac{13}{15})+58\frac{7}{12}=?$

8. Sold goods at 35% profit, gaining $12.25; find the cost.

9. Change £15 10s. to U. S. Money.

10. A tub which holds 600 gal. will hold how many bu.?

375. 1. Reduce 4 mi. 24 rd. 2 ft. to feet. (S. 30.)

2. Sold a wagon for $199.50, gaining 14%; how much did it cost? (S. 26.)

3. What is the value of 256 planks 16 ft. long, $2\frac{1}{2}$ in. thick, and averaging 15 in. wide, at $24 per M.?

4. Sold a horse for $200; sent the owner $176; what was the rate of commission?

5. 4 sections of land make how many 160-acre farms?

6. Find $\frac{1}{9}$ of the sum of $7\frac{7}{8}$, $8\frac{5}{9}$, $8\frac{2}{3}$ and $5\frac{7}{15}$.

7. Multiply $\$48\frac{3}{4}$ by $78\frac{2}{3}$. 8. $7500.25\div.025=?$

9. How many cubic yards in a cubic rod?

10. Change 9 cable-lengths to chains.

11. How many feet in 3.7 miles?

12. Change 157 geographic miles to common miles.

II. INTEREST.

376. Interest is compensation for the use of money.

Interest is computed as *percentage*, the terms *Principal*, *Rate* and *Interest* respectively corresponding to the base, rate and percentage.

The **Principal** is the sum for the use of which interest is paid.

The **Rate** is the per cent paid on one dollar for a certain time — one year, unless otherwise specified.

The **Time** is the period for which interest is paid.

The **Amount** is the sum of the interest and principal.

Legal Interest is interest at the rate fixed by law; interest at a higher rate is called *Usury*.

The legal rate of interest varies in different States; when no special rate is indicated, the legal rate is understood.

377. Exercises. — (S. 27.)

1. Find the interest of $5 for 1 yr. at 6% ; at 8%.
2. Find the interest of $30 for 2 yr. at 6% ; for 3½ yr.
3. Find the interest of $20 for 1 yr. at 7% ; for 6 mo.
4. Find the interest of $24 for 2 yr. 4 mo. at 10%.
5. Find the amount of $40 for 1 yr. 6 mo. at 8%.
6. Find the amount of $250 for 4 mo. at 1% per mo.
7. Find the amount of $80 for 7½ mo. at 6%; at 8%.
8. Find the interest of $600 for 1 mo. at 6% ; for 15 da.

378. 1. Find the interest of $30 for 30 da. at 8%; for 33 da.

2. Find the amount of $400 for 60 da. at 9%; for 63 da.
3. Find the amount of $250 for 2½ mo. at 2% a month.
4. Find the amount of $150 for 7 mo. 6 da. at 10%.
5. Find the amount of $75 for 93 da. at 12%.
6. Find the int. of $200 from June 6 to Oct. 6, at 8%.
7. Find the amt. of $350 from May 1 to Aug. 16, at 6%.
8. Find the int. of $80 from Jan. 10 to Apr. 20, at 12%.
9. Find the amt. of $400 from Apr. 7, to July 22, at 1% per month.

379. 1. Find the int. of $243 for 2 yr. 9 mo. 5 da. at 8%.

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OPERATION. — $243
              2.43, int. of $243 for 1 yr. at 1% (Art. 202, IV.)
                8
         12) 19.44, int. for 1  yr., ×2=$38.88, int. for 2  yr.
          30)1.62,  "    "  1 mo., ×9= 14.58,  "    "  9 mo.
              .054, "    "  1  da., ×5=    .27,  "    "  5 da.
                                      $53.73
```

EXPLANATION. — The interest of $243 for 1 yr. at 8% is $19.44, and for 2 yr., 2 times $19.44, or $38.88; the interest of $243 for 1 mo. at 8% is 1 twelfth of $19.44, or $1.62, and for 9 mo. 9 times $1.62, or $14.58; the interest of $243 for 1 da. at 8% is 1 thirtieth of $1.62, or $.054, and for 5 da. 5 times $.054, or $.27; and the interest of $243 for 2 yr. 9 mo. 5 da. at 8% is $53.73.

2. Find the amount of $84 for 2 yr. 9 mo. at 7%.
3. Find the int. of $256 for 3 yr. 5 mo. 17 da. at 9%.
4. Find the amt. of $213 for 2 yr. 1 mo. 25 da. at 8%.
5. Find the amt. of $184.40 for 1 yr. 7 mo. 11 da. at 6%.
6. Find the amt. of $234.60 for 2 yr. 21 da. at 8%.
7. Find the amt. of $176.25 for 7 mo. 18 da. at 5%.

380. 1. Find the int. of $45.75 for 2 mo. 3 da. at 6%.
2. Find the amt. of $236 for 11 mo. 23 da. at 12%.
3. Find the amt. of $350 for 7 mo. 12 da. at 4%.
4. Find the circumference of a circle 12 ft. in diameter.
5. 3 ft. 6 in. are what part of a rod? decimal part?
6. What cost 9 A. 70 sq. rd. of land at $65 per A.?
7. What is a surface? a solid? a cube? an arc?

381. 1. Find the int. of $380 for 10 mo. 18 da. at 8%.
2. Find the amt. of $256.80 for 7 mo. 8 da. at 6%.
3. Find the amt. of $257 for 3 mo. 3 da. at 12%.
4. Find the amt. of $754 from Aug. 4 to Oct. 9 at 8%.
5. Find the time from Feb. 17, 1821 to May 4, 1879.
6. What cost 15 lb. 10 oz. of butter at $\$.18\frac{3}{4}$ per lb.?
7. If 4 men earn $22 in 2 days, in how many days will 6 men earn $66?
8. What number plus its half and its third gives $121?
9. Gained $16.40 at $7\frac{1}{2}\%$; find the cost; the gain.

382. 1. Find the int. of \$180 for 63 da. at 8%. (S. 27.)

ANALYSIS. — The int. of \$180 for 1 yr. at 1% is 1 one-hundredth of \$180; at 8%, 8 times as much; for 1 da. 1 three hundred sixtieth as much; for 63 da., 63 times as much, canceling common factors from both dividend and divisor, \$$\frac{63}{25}$, or \$2.52.

OPERATION. —

$$\frac{\$180\times\overset{4}{8}\times 63}{\underset{25}{100}\times\underset{2}{360}}=\$\tfrac{63}{25}=\$2.52$$

2. Find the int. of \$156 for 45 da. at 6%.

3. Find the amt. of \$212 for 36 da. at 12%.

4. Find the amt. of \$514 from May 7 to July 4 at 6%.

5. A has \$39.60, B has 20% more than A, and C 20% less than both A and B; how much have all?

6. How many board feet in a piece of timber 22 ft. long, 20 in. wide and 16 in. thick?

7. What cost $6\frac{3}{4}$ yd. of cloth at \$3.60 per yd.?

383. 1. Find the int. of \$342 for 2 mo. 6 da. at 9%.

2. Find the amt. of \$158 from Aug. 15 to Sept. 29 at 10%.

3. Find the amt. of \$145 from Apr. 9 to Aug. 4 at 7%.

4. Find the amt. of \$718 from May 2 to June 27 at 8%.

5. How many bricks 4 by 8 in., will pave a walk 2 yd. wide and 12 rd. long?

6. How many sq. yd. of plastering in the walls and ceiling of a room 17 ft. by 21 ft., 15 ft. high?

7. $\frac{2}{3}$ of a foot are what part of a rod?

384. 1. Find the int. of \$309 for 3 mo. 7 da. at 10%.

2. Find the amt. of \$276 for 3 yr. 5 mo. 18 da. at 6%.

3. Find the amt. of \$97.60 for 7 mo. 12 da. at 8%.

4. Richard had a certain sum of money; he earned \$17.20 more, spent \$12.25, and then found that he had \$23.85; how much had he at first?

5. If 27 men can build a road in 30 days, how many more men must be employed to do it in 18 days?

6. What is the value of 29 car loads of coal averaging $11\frac{4}{5}$ tons each, at \$8.25 per ton?

7. \$342.16 are 8% of what? 8. $\frac{5}{9}$ are $\frac{7}{8}$ of what?

9. What cost a farm $\frac{3}{4}$ mi. square at \$57.50 per acre?

385. 1. Find the interest of $71.60 for 93 da. at 6%.

2. Find the amt. of $147.75 from Nov. 12 to Feb. 3 at 6%.

3. Find the amt. of $212 from Mar. 10 to May 7 at 8%.

4. Find the amt. of $137.65 for 3 yr. 4 mo. 9 da. at 5%.

5. Find the amt. of $234.25 from Feb. 7 to Apr. 5 at 7%.

6. Bought 23680 lb. of coal at 9 cents a bushel of 80 lb.; how much did it cost?

7. How much will it cost to carpet a room 17 ft. by 20 ft., with carpet $\frac{3}{4}$ yd. wide, at $1.15 a yard, the strips to run crosswise and turn under $\frac{1}{4}$ yd.?

8. Sold a watch for $112, gaining 40%; find the cost.

9. Change £15 to U. S. Money. 10. $350.1 \div .389 = ?$

386. 1. Find the int. of $240 for 45 da. at 10%.

2. Find the amt. of $431 for 3 yr. 7 mo. 12 da. at 7%.

3. Find the amt. of $516 from Oct. 19 to June 7, at 6%.

4. Find the amt. of $83 for 9 mo. 23 da. at 8%.

5. Find the amt. of $176.40 for 63 da. at $7\frac{1}{2}$%.

6. A tank 7 feet square at the top and bottom, contains 588 cu. ft.; how deep is it?

7. What is an angle? Make an angle of 45°.

8. Sold a carriage for $211.90, gaining 14%; find the gain.

9. Paid $80 for a pile of wood 64 ft. long, 6 ft. high, and 4 ft. wide; what was the price per cord?

10. $7\frac{2}{3}$ are what part of $18\frac{3}{4}$? 11. $\$437\frac{3}{4} \div \$9 = ?$

387. In **Accurate Interest**, the year is 365 days, instead of 360 days as in common interest. Problems in accurate interest are solved as in Art. 382, using 365 instead of 360.

1. Find the accurate int. of $265 for 146 da. at 8%. (S. 27.)

2. Find the accurate int. of $365 for 97 da. at 9%.

3. Find the accurate int. of $560 for 212 da. at 6%.

4. Find the accurate int. of $460 for 93 da. at 5%.

5. Find the square of 165. 6. $127\frac{3}{8} \div 29\frac{11}{12} = ?$

7. A collects $2360; find his com'n at $2\frac{1}{2}$%; the proceeds.

8. Find the amt. of a sale, if the commission at $2\frac{1}{4}$%, is $27.

9. If $\frac{1}{6}$ of the selling price is profit, what % is gained?

10. Tell all you can about Troy weight.

388. Compound Interest is interest on the principal and the interest due combined at stated intervals, as annually, semi-annually, etc.

389. 1. Find the amount of $400 for 3 yr. 8 mo. at 10%, the interest compounded annually.

EXPLANATION. — The int. of $400 for 1 yr. at 10% is $40, and the amt. of the principal and int. at the end of the 1st yr. is $440; taking this as a new principal, the int. for the 2nd yr. is $44, and the amt. at the end of the 2nd yr. is $484; taking this as a new principal, etc.

OPERATION. —

Principal,	$400.
Int. 1st yr.,	40.
Amt., new prin.,	440.
Int. 2nd yr.,	44.
Amt., new prin.,	484.
Int. 3d yr.,	48.40
Amt., new prin.,	532.40
Int. 8 mo.,	22.16
Comp. Amt.,	$554.56

2. What is the amt. of $786 for 5 yr. 3 mo., at 18%, the interest compounded annually?

3. What is the amt. of $3600 for 2 yr. 10 mo., at 6%, the interest compounded semi-annually?

NOTE. — 6 per ct. a year equals 3 per ct. for each half-year period.

4. By selling cloth at $1.10 per yd., $\frac{2}{3}$ of the cost is gained; what per cent is gained?

5. The product of three factors is $56\frac{2}{3}$; one of them is $3\frac{1}{5}$, another is $4\frac{3}{4}$; find the third.

6. If $\frac{5}{8}$ of a ton of coal cost 8\frac{3}{4}$, what cost $6\frac{1}{2}$ tons?

7. $\frac{5}{8}$ of a ton of hay cost 8\frac{3}{4}$; how much will $50 buy?

390. 1. Sold cloth at $1.10, losing $8\frac{1}{3}$%; find the loss.

2. If $\frac{1}{5}$ of the selling price is profit, what % is gained?

3. Bought milk at $.30 a gallon, and sold it at 10 cents a quart; what % was gained?

4. Goods sold for $6.40, cost $10; what % was lost?

5. Change £156 15s. to U. S. Money.

6. What cost 187.5 lb. of lead at $6.50 per 100 lb.?

7. What cost $5\frac{3}{4}$ tons of coal at 9 ct. per bu. of 80 lb.?

8. How many acres in a road $1\frac{5}{8}$ mi. long 99 ft. wide?

9. Give the table for Long Measure; Apothecaries' wt.

10. Find the amt. of $314 at 8% from May 9 to Aug. 1.

391. 1. Find the amt. of \$576 for 4 yr. 7 mo. at 6%; the interest compounded annually.

2. Sold a lot for \$480, losing 25%; find the cost.

3. Find the amt. of \$240 at 1% a mo. from May 6 to Aug. 2.

4. A fox, 90 rd. ahead of a hound, runs 15 rd. while the hound runs 20 rd.; how far must the hound run to catch the fox?

5. A 15-acre field is 40 rd. long; how wide is it?

6. How many inches in all the edges of a 16-in. cube?

7. How many cu. yd. in an excavation 90 ft. long, 26 ft. wide and $7\frac{1}{2}$ ft. deep?

8. When a tax of 14 mills on a dollar is levied, how much tax does a man pay on \$7600?

392. 1. What cost 19700 bricks at \$9.50 per M.?

2. A lot 8 rd. by $7\frac{1}{2}$ rd. is what % of an acre?

3. Find the area of a circle 17 ft. in diameter.

4. How many sq. yd. in the walls and ceiling of a room 21 ft. long, 18 ft. wide and 16 ft. high?

5. Find the amt. of \$98.90 for 6 mo. 17 da. at 8%.

6. How many board feet in 217 boards 12 ft. long, $1\frac{1}{2}$ in. thick and 16 in. wide? Value at \$17.50 per M.?

7. If I sell $\frac{3}{5}$ of a piece of land and have 285 acres left, how much was there at first?

8. What part of $\$3\frac{3}{4}$ are $\$2\frac{1}{5}$?   9. Divide $\$785\frac{4}{5}$ by \$8.

393. 1. Add $17\frac{5}{8}$, $19\frac{3}{10}$, $56\frac{7}{12}$ and $24\frac{23}{30}$.

2. $\$10\frac{1}{2}$ are what % of \$63.   3. $15\frac{7}{18} \times 15\frac{7}{18} = ?$

4. What is the amt. of \$288.75, at 8%, from Nov. 22, 1886, to May 2, 1888?

5. $\frac{2}{3}$ of a farm sold for \$13000; what % of the remainder would \$3900 buy at the same rate?

6. An agent's commission at $1\frac{1}{2}$% was \$57.30; find the amoun of the sale; the proceeds.

7. What is the area of a triangular field, the base being 36 rd. and the altitude of the triangle 24 rd.?

8. $4\frac{2}{3}$ ft. are what % of $7\frac{2}{3}$ ft.?   9. Find $\frac{7}{8}$% of $\$3\frac{2}{5}$.

10. Find the amt. of \$156 for 63 da. at 8%.

11. Divide 64 bu. 2 pk. by 2 bu. 1 pk.

III. NOTES, AND PARTIAL PAYMENTS.

394. A Promissory Note is a written promise to pay a sum of money at a specified time.

The **Face** of a note is the sum named in it.

The **Maker** or **Drawer** of a note is the party who makes the promise or signs the note.

The **Payee** is the party to whom the note is payable.

A **Negotiable Note** is one payable to 'bearer' or to 'order.'

An **Indorser** of a note is one who writes his name on the back of the note, making himself responsible for its payment.

The **Maturity** of a note is its becoming legally due.

A *Demand* note is due on presentation; a *Time* note, in most States, matures three days after the time specified in the note.

Days of Grace are three days allowed by law for the payment of a note after it becomes legally payable.

395. Partial Payments are payments in part of notes or other obligations.

An Indorsement is a statement of the amount and time of a payment, generally written on the back of an obligation.

In finding the amount due on an interest-bearing note on which partial payments have been made, the United States Court Rule is generally followed: (S. 28.)

Rule. — *I. Find the interest of the principal to the date of the first payment.*

II. If the payment equals or exceeds the interest, subtract it from the amount then due, and treat the remainder as a new principal, continuing the process to the time of settlement.

III. If any payment be less than the interest due, add the payment to the next, and treat the sum as one payment at such time as it shall equal the interest due.

396. Exercises. —

1. The following note was indorsed Mar. 18, 1883, $65; Oct. 30, 1884, $40; Feb. 14, 1885, $200; what was due May 9, 1885?

$500.00 CLEVELAND, O., *Jan. 12, 1883.*

On demand, I promise to pay to the order of JOHN MANN, *Five hundred Dollars*, with interest at *six per cent.* per annum, Value received. *David Hume.*

OPERATION. —

	Principal, or face of note,	$500.00
yr. mo. da.	Int. to Mar. 18, 1883,	5.50
85—5—9	Amount due,	505.50
85—2—15	1st. payment,	65.00
84—10—30	Balance due, new principal,	440.50
83—3—18	Int. to Oct. 30, 1884, and to Feb. 18, 1885,	50.43725
83—1—12	Amount due,	490.93725
2—6, $65,	2d. and 3d. payments $40+$200,	240
1—7—12 $40,	Balance due, new principal,	250.937
3—15 $200,	Int. to settlement, May 9, 1885,	3.513
2—24	Amount due,	$254.45

EXPLANATION. — The difference between the dates is found, as on the left, by Art. 287. The first payment exceeding the interest due at the date of the payment, is taken from the amount of the principal and interest, and the balance taken as a new principal. The second payment is less than the interest due at that date, consequently it is added to the third payment, and the sum exceeding the total interest due at that date, is taken from the amount then due, and the balance taken as a new principal. Of this, the amount is found at the date of settlement.

2. What was due at settlement on the following? —

$260.00 ST. PAUL, MINN., *June 10, 1882.*

Sixty days after date, we promise to pay to the order of JOHN WILSON, *Two hundred sixty and* $\frac{00}{100}$ Dollars, for value received, with interest at *eight* per cent. per annum until paid.

Thomas Dorland,
Willis Wright.

Indorsed: May 18, 1883, $60; Oct. 20, 1883, $127; paid in full Jan. 20, 1884.

What kind of a note is this? What does Wilson become, if he sells it?

397. 1. What cost 3690 lb. of hay at $12.50 per ton?

2. What was due Jan. 9, 1888, on an 8% note for $316, dated May 10, 1886, — indorsed Oct. 20, 1886, $75, — Mar. 1, 1887, $28?

3. Sold a watch for $$82\frac{1}{2}$, gaining $\frac{7}{8}$ of the cost; find the gain.

4. Sent A $250 to buy a horse; he returned with the horse $29.50, saying that he had charged me 5% commission; find the price of the horse.

5. What sum plus 18% of itself gives $121.54?

6. 7 ft. 6 in. are what % of a rod? 7. Multiply $49\frac{3}{4}$ by $78\frac{2}{3}$.

398. 1. A and B can do a piece of work in 7 days, A alone in 12 days; how long will it take B alone?

2. What cost $7\frac{3}{4}$ tons of coal at $8\frac{1}{2}$ cents per bu. of 80 lb.?

3. Find the amt. of $338 from Jan. 7, to Aug. 1, at 6%.

4. 7 lb. 5 oz. of silver will make how many 2-oz. spoons?

5. What are 2 sections of land worth at $$2\frac{1}{2}$ per acre?

6. What was due July 3, 1886, on a 7% note for $240, dated Jan. 1, 1882, — indorsed June 10, 1882, $56, — Dec. 20, 1883, $30, — Sept. 18, 1884, $75?

399. 1. What cost 37650 bricks at $9.60 per M.?

2. $$12\frac{4}{5}$ are $33\frac{1}{3}$% less than what amount?

3. What fraction divided by $\frac{7}{9}$ will give $119\frac{3}{16}$?

4. Change £756 to U. S. Money; to French Money.

5. An 8% note for $79, dated Feb. 1, 1883, was indorsed Jan. 3, 1884, $18; what was due July 5, 1884?

6. Find the accurate interest of $756 for 33 at 8%.

7. Multiply 47 rd. $5\frac{1}{2}$ ft. by 4. 8. Find $2\frac{3}{4}$% of $$5\frac{5}{8}$.

400. 1. Sold a horse for $60, which was $12 more than $\frac{2}{3}$ of the cost; find the cost.

2. What will it cost to fence a 15-acre field, 60 rd. long, at $$1.37\frac{1}{2}$ a rod?

3. Find the amt. of $98 from Nov. 9 to Apr. 3, at 8%.

4. What was due Jan. 7, 1885, on an 8% note for $142, dated May 9, 1884, — endorsed July 20, 1884, $29?

5. 75 lb. of tea cost $$51\frac{1}{4}$; how many lb. will $$92\frac{1}{2}$ buy?

6. Find the amt. of $563 for 93 days at 9%.

401. 1. A note for \$256.20, dated May 7, 1887, payable in 90 days, was indorsed at maturity, \$86.45, — Nov. 25, 1887, \$45. What was due Jan. 28, 1888, the legal rate of int. being 6%?

2. Change $27\frac{1}{2}°$ of latitude to statute miles.

3. A farm 120 rd. long cost \$5400 at \$75 per acre; how wide was it?

4. A clock gains $\frac{2}{5}$ of a min. every 5 hours; how much will it gain in 2 weeks?

5. Cost, $\$7\frac{1}{2}$; sold for \$9.60; find the rate of gain.

6. $\$683\frac{4}{5} \div \$9 = ?$ 7. $\$4\frac{3}{4}$ are what % of $\$7\frac{3}{5}$?

402. 1. \$21.60 are 20% less than what amount?

2. Cost \$270; profit $16\frac{2}{3}\%$; find the selling price.

3. How many gal. will a tank 10 ft. × 6 ft. × 6 ft. hold?

4. Change $\frac{5}{8}$ of a year to integers of lower order.

5. What cost 29875 lb. of coal at \$9.75 per ton?

6. Find the bal. on an 8% note for \$443, dated Apr. 7, 1886, — indorsed Aug. 19, 1886, \$28, — Feb. 3, 1887, \$141, — June 30, 1887, \$36, and settled Nov. 13, 1887.

7. Sale, \$200; proceeds, \$184; find the rate of commission.

403. 1. Find the area of a circle 5 ft. in diameter.

2. How long must \$240 be on interest at 8% to gain \$40? (\$240 gain how much in *one* year?)

3. 29 boards 14 ft. long, 9 in. wide, $1\frac{1}{4}$ in. thick, cost how much at \$18 per M.?

4. \$300 gain \$35 in 1 yr. 8 mo. at what rate of interest? (\$300 gain how much in the time at *one* %?)

5. $\$89.10 \div \$24\frac{3}{4} = ?$ 6. Find $\frac{3}{8}\%$ of $95\frac{3}{5}$.

7. Find the amt. of \$186.40 for 3 yr. 7 mo. 12 da. at 10%.

404. 1. A man owning $165\frac{3}{4}$ acres of land, sold $\frac{3}{4}$ of it for \$5670; what was the price per acre?

2. Sold for \$4215.75, gaining $\frac{3}{8}\%$; find the cost.

3. A watch and chain cost \$75; the watch cost 4 times as much as the chain; find the cost of each.

4. A boy paid $\frac{2}{7}$ of his money for a pair of skates costing $\$2\frac{4}{5}$; how much had he left?

5. Change 9 lb. Tr. to av. wt. 6. Find $5\frac{1}{2}\%$ of £56 15s.

III. DISCOUNT.

405. Discount is a deduction from a nominal price or value.

Banks lend money taking the interest in advance,— this interest taken in advance is called *Bank Discount.*

When goods that are commonly sold 'on time,' are paid for at once, or in shorter time, a deduction called *Cash Discount* is made.

For instance, A sells goods to B; it may be customary in this line to allow 90 days time; as an inducement to B, A may throw off 5% for payment in 30 days, or 6% for cash.

A *list price*, or nominal retail price, is often fixed on goods; from this a deduction called *Trade Discount* may be made for the benefit of parties purchasing to sell again, or for payment within a fixed time.

For instance, a manufacturer fixes a *list price* on hats at $5.00; in order that the jobbers and retailers may make a reasonable profit, he may allow 30% off for the latter, and 20% for the former, for payment in 90 days; —that is, he sells for $5.00 less 30% of —, less 20% of —, or for $2.80. He might make a further discount for cash, say 5%, selling at $2.66. The jobber may sell to the retailer at $5.00 less 30% of —, on 90 days time, or $5.00 less 30% of —, less 5% of —, for cash or 30 days.

406. Exercises. —

1. Find the discount, and the *net cost*, on a bill of goods bought at 30% off, the list price being $550.
2. What is the net price of goods billed at $216 on 30 days time, and 5% off for cash?
3. What is the net cost of an invoice of books billed at $312.80, less 25%, and 4% for cash?
4. Paid $37.80 for goods at 30% off; find the list price.
5. Find the amt. of $280, at $7\frac{1}{2}$%, from Feb. 13 to May 7.
6. What cost 3650 lb. of coal at $8.25 per ton?
7. What cost 7 lb. 5 oz. of butter at $.25 per lb.?
8. How many pills, each *gr.* iij, will 5℥ of quinine make?

407. 1. What sum at 6% int. gains $750 a year?

2. Find the amt. of $314 from Dec. 19 to Apr. 11, at 8%.

3. Sold a bill of shoes listed at $228, at a discount of $\frac{1}{3}$, and 5% for cash; find the amt. received.

4. Bought a lot of books for $73.15, at 30% and 10% off; what was the list price?

5. If you borrow at a bank for 60 days, at 8%, how much will you get for your note for $250? (S. 29.)

NOTE. — The bank is supposed to deduct the int. on the principal at the given rate, for 63 days — the time plus 3 'days of grace'.

6. Divide 70 by 9.376. 7. $8\frac{2}{9}$ are what part of $18\frac{3}{4}$?

408. 1. A box 9 ft. square at the top and bottom contains 891 cubic feet; how deep is it?

2. A 12-acre field is 60 rods long; how wide is it?

3. 20.6 tons of coal cost $110.21; what cost 16.5 tons?

4. What sum invested at 6% gains $60 per mo.?

5. A telegraphs B to buy him 150 bbl. of flour. B does so, charging 2% commission; the whole bill amounts to $1147.50; find the cost of the flour.

409. 1. 1466 lb. are what % of a ton?

2. Sold goods for $42.25, gaining 35%; find the gain.

3. Paid $35 for a watch at 20% off; find the list price.

4. Find the amt. of $715 from Nov. 22 to May 8, at 8%.

5. What cost 9 lb. 13 oz. of butter at $.37$\frac{1}{2}$ per lb.?

6. What cost 82 plank 16 ft. long, 10 in. wide and 3 in. thick, at $23.50 per M.?

7. $11\frac{1}{2}$ A. of land cost $724.50; 240 sq. rd. cost what?

410. 1. $90 were paid for a pile of wood 64 ft. long, 6 ft. high and 4 ft. wide; what was the price per cord?

2. Sold 27 doz. hats, listed at $27.50 per doz., at $\frac{1}{3}$ and $\frac{1}{10}$ off, and 5% discount for cash; find the net amount.

3. A 6-inch square is what part of a 12-inch square?

4. A floor 15 ft. wide contains 35 sq. yd.; how long is it?

5. Find the amt. of $156.30 for 7 mo. 19 da. at 7%.

6. Change .13$\frac{1}{3}$ to a common fraction.

7. Find the amt. of $320 for 93 days at 8%.

POWERS AND ROOTS.

I. DEFINITIONS.

411. A Power is the product of equal factors.

The **Square** or **Second Power** of a number is the product of the number taken twice as a factor, — that is, the product of three equal factors. Thus, 16 is the square of 4. (See Art. 46.)

The **Cube** or **Third Power** of a number is the product of the number taken three times as a factor, — that is, the product of two equal factors. Thus, 27 is the cube of 3.

A power of a number may be indicated by placing a small figure, called an *Exponent*, after and above the number written in figures. Thus, 5^3 indicates the cube of 5.

412. A Root of a number is one of its equal factors.

The **Square Root** of a number is one of its *two equal factors.*

The **Cube Root** of a number is one of its *three equal factors.*

A root of a number may be indicated by placing the *Radical Sign* before the number written in figures. Thus, $\sqrt{64}$ indicates the square root of 64, and $\sqrt[3]{64}$ indicates the cube root of 64.

A *Perfect Power* is one of which a desired root may be found exactly. Thus, 64 is both a perfect square and a perfect cube.

An *Imperfect Power* is one of which a desired root may be found approximately only. Thus, 50 is an imperfect square; for, while it is *supposed* to be the product of two equal factors no two equal factors giving 50 as a product can be found.

In practice, perfect powers are not common.

413. Exercises. —

1. Make a table of the squares of the numbers 1 to 25.

2. Make a table of the cubes of the numbers 1 to 10.

3. Find the square of 47; 59; 184; 785.

4. Find the square of $\frac{5}{6}$; $\frac{8}{9}$; $\frac{14}{19}$; $\frac{74}{91}$.

5. Find the square of .5; .25; .99; .007; 2.4; 4.75.

6. Find the cube of 15; 36; $\frac{5}{8}$; $\frac{4}{9}$; .5; .75; 2.7.

7. Find the amt. of $217 from Mar. 19 to Aug. 7, at 8%.

8. 464 cu. yd. of earth were taken from an excavation 36 ft. wide and 48 ft. long; how deep was it?

9. How many gallons of water in 7 cu. ft.?

10. Sold cloth at $1.10 losing $8\frac{1}{3}$%; find the loss.

414. 1. Take any small number, — find its square; find the square of twice the number; compare the squares.

2. Find the cube of 3; of 6; compare the cubes.

3. John and James have $154; James has three fourths as much more than John; how much has each?

4. Find the surface of an 18-inch cube; an 18-inch sphere.

5. What cost $5\frac{1}{2}$ mi. of telegraph wire at \$.04$\frac{1}{2}$ per yd.?

6. Find the accurate interest of $567 for 65 days, at 10%.

7. How much hay at $9 per ton cost $13.50?

8. At what rate will $500 yield $100 in 2 yr. 6 mo.?

9. At what rate will a sum of money double itself in 20 yr.?

10. In what time will $256 amount to $512 at 8%?

415. 1. My house, worth $7500, is insured for $\frac{2}{3}$ of its value at $\frac{3}{8}$; find the premium.

2. Reduce $\frac{4}{7}$ of a £ to integers of lower order.

3. $15.60 were lost at $1\frac{1}{2}$%; find the selling price.

4. Find the diameter of a circular pond 75 rd. in circuit.

5. What is the area of a triangular tract of land, the base being 96 rd. and the altitude 60 rd.?

6. Smith pays $25.25 tax on $3500; what is the rate?

7. In what time will $302.20 gain $193, at 8%?

8. In finding $\frac{2}{3}$ of $\frac{5}{7}$, why multiply the denominators together? why multiply the numerators?

9. What cost a sight draft for $950 at $\frac{3}{4}$% premium?

II. THE SQUARE ROOT.

416. If a table of the squares of the numbers 1 to 9, 10 to 99, 100 to 999, etc., be made it is readily seen that —

I. The square of a 1-place number contains 1 or 2 places,
The square of a 2-place number contains 3 or 4 places,
Etc., then,

II. The square root of a 1 or 2-place number contains 1 place,
The square root of a 3 or 4-place number contains 2 places,
Etc., then,

III. The square root of any number found in the first two places to the left of the decimal point is *ones;* in the second two places, *tens;* etc.

The square root of any number found in the first two places to the right of the decimal point is *tenths;* in the second two places, *hundredths;* etc. Hence,

The places occupied by the square root of any number are determined by 'pointing off' the number into periods of two places each, beginning at the decimal point. Thus, the square root of 3765 consists of tens and ones, that of 7.3563 of ones, tenths and hundredths.

417. To Find the Square Root of a Number:

I. Separate the number into periods of two places each, beginning at the decimal point.

II. Find the greatest square in the left hand period; take its square root for the highest order of the required root; subtract the square from the left hand period, and annex to the remainder the next period for a dividend.

III. Double the part of root already found, for a trial divisor to find the next lower order of the required root.

IV. Add the number last found to the trial divisor, and multiply the sum by the part of the root last found; subtract the product from the dividend, annex the next period, and proceed in the same manner to find the next lower order of the required root.

NOTES. — 1. A left hand period may have but one place.

2. Periods of decimal orders may be annexed by Art. 202.

418. Exercises. —

1. Find the square root of 561.69.

ANALYSIS. — By Art. 416, the square root of 561.69 contains three places, — *tens*, *ones* and *tenths* — it may contain more. The square of the *tens* is found in the left hand period, 5 (00); the largest square in the period is 4; its square root is 2. Subtracting the square from the left hand period and annexing the next period, 161 is found for a dividend.

```
                OPERATION. —
                   5′61.69′ (23 7
                   4
      20×2=40)    161
           43)    129
  23.0×2=46.0)    32.69
        46.7)     32.69
```

Taking twice the part of the root already obtained, 2 (0), 40 is found for a trial divisor, which gives 3 for the next lower order of the required root. Adding this to the trial divisor, multiplying, subtracting, and annexing the next period, 32.69 is found for a dividend. Taking twice the part of the root already obtained, 46.0 is found for a trial divisor, which gives 7, etc.

2. 2916
3. 1296
4. 9801
5. 23409
6. 53824
7. 543867
8. $\frac{3}{4}$ are what % of $\frac{4}{5}$?
9. $2\frac{3}{4}$ are $\frac{5}{8}$% of what?
10. Find the area of an 18-inch circle.

419. Find the square root of —

1. 8649
2. 54756
3. .4096
4. 123.21
5. 1169.64
6. 77.6161
7. 7.396
8. 58.2
9. What is the length of a square containing 4 acres?
10. If $\frac{1}{4}$ of the selling price is profit, what % is gained?

420. Find the square root of —

1. 32.49
2. $\frac{121}{144}$
3. $\frac{1369}{2209}$
4. $1\frac{3}{5}$
5. 15.21
6. $\frac{81}{256}$
7. $\frac{1296}{2304}$
8. $23\frac{5}{6}$

NOTE. — In finding the square root of a common fraction, extract the square root of both terms, or change the fraction to a decimal and find the required root.

9. Find the square root of $\frac{5}{7}$; of $\frac{19}{125}$; of $15\frac{7}{11}$.
10. A's horse cost $1\frac{5}{8}$ times as much as his carriage; what % of the cost of both was the cost of the carriage?
11. B is 45% greater than C; what % of B is C?
12. What is a promissory note? Write one.
13. What is a Troy pound? A Gunter's Chain?

III. THE CUBE ROOT.

421. If a table of the cubes of the numbers 1 to 9, 10 to 99, 100 to 999, etc., be made it is readily seen, that —

I. The cube of a 1-place number contains 1, 2 or 3 places,
The cube of a 2-place number contains 4, 5 or 6 places,
Etc., then,

II. The cube root of a 1, 2 or 3-place number contains 1 place,
The cube root of a 4, 5 or 6-place number contains 2 places,
Etc., then,

III. The cube root of any number found in the first period on the left of the decimal point is *ones;* in the second, *tens;* etc.

The cube root of any number found in the first period on the right of the decimal point is *tenths;* in the second, *hundredths;* etc. Hence,

The places occupied by the cube root of any number are determined by the periods occupied by the number.

422. To Find the Cube Root of a Number:

I. Note the periods occupied by the number, completing a right hand period with decimal ciphers, if necessary.

II. Find the greatest cube in the left hand period; take its cube root for the highest order of the required root, subtract the cube from the left hand period, and annex to the remainder the next period for a dividend.

III. Take three times the square of the part of the root already found, for a trial divisor to find the next lower order of the required root.

IV. Add to the trial divisor three times the part of the root already found multiplied by the last part found, and the square of the last part. Multiply the sum by the part of the root last found, subtract the product from the dividend, and to the remainder annex the next period for a new dividend. Proceed in the same manner to find the next lower order of the required root.

NOTES. — 1. A left hand period may have but one place.

2. Periods of decimal orders may be annexed by Art. 202.

423. Exercises. —

1. Find the cube root of 79356.

ANALYSIS. — By Art. 421, the cube root of 79356 contains two places, — *tens* and *ones* — it may contain more. The cube of the *tens* is found in the left hand period, 79 (000); the largest cube in 79 is 64; its cube root is 4. Subtracting the cube from the left hand period and annexing the next period to the remainder, 15356 is found for a dividend.

OPERATION. —

$$
\begin{array}{rl}
 & 79356(42.9+ \\
4\times4\times4= & 64 \\
40\times40\times3=4800) & \overline{15356} \\
40\times3\times2= & 240 \\
2\times2= & 4 \\
\overline{5044)} & 10058 \\
420\times420\times3=5292.00) & \overline{5268.000} \\
420\times3\times9= & 113.40 \\
9\times9= & .81 \\
\overline{5406.21)} & 4865.589 \\
 & \overline{402.411}
\end{array}
$$

Taking three times the square of 40, the part of the root already obtained, 4800 is found for a trial divisor, giving 2 for the next lower order of the required root. Adding to this trial divisor three times 40, the part of the root previously obtained, multiplied by the part last found, and the square of the last part, gives 5044 for a complete divisor; this, multiplied by the part of the root last found, gives, after subtracting, 5268, to which a decimal period may be annexed and the next lower order of the required root found.

2. 15625
3. 4096
4. 74088
5. 12.167
6. 91.125
7. 85184
8. 41063625
9. 1259.712

10. Paid $939.36 for a bill of exchange on London at $\$4.89\frac{1}{2}$; what was the face of the bill?

11. What tax assessment gives $75.40 at $4\frac{1}{2}$ mills on $1?

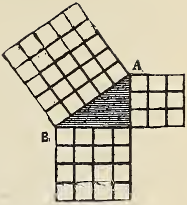
424. 1. If $\frac{3}{4}$ of an inch of rain fall, how many barrels will a cistern receive from a roof 23 ft. by 87 ft.?

Find the cube root of —

2. .042875
3. 74.088
4. $3\frac{3}{8}$
5. $49\frac{7}{81}$
6. $7\frac{1}{5}$
7. 5.7
8. $3\frac{3}{5}$
9. 4

NOTE. — In finding the cube root of a common fraction, extract the cube root of both terms, or change the fraction to a decimal and find the required root.

10. Find the cube root of $\frac{15}{16}$; the square root of $\frac{5}{8}$.
11. How much invested at 8% gives $60 per month?
12. Find the perimeter of a square containing 16 acres.
13. What is discount? Commercial discount?



425. In any **right-angled** triangle the square on the hypotenuse equals the sum of the squares on the base and perpendicular. Then,

I. The hypotenuse equals the square root of the sum of the squares of the base and perpendicular.

II. The base, or perpendicular, equals the square root of the difference of the squares of the other two sides.

426. Exercises. —

1. The base and perpendicular of a right-angled triangle are 12 ft. and 15 ft.; find the hypotenuse.

2. The hypotenuse of a right-angled triangle is 10 ft. and the perpendicular is 8 ft.; find the base.

3. Hypotenuse 25 in.; base 18 in.; find the altitude.

4. Find the diagonal of a room 16 ft. by 18 ft.

5. How long is a path diagonally across a square field of 10 A.?

6. What will it cost at $1.75 a rod to fence a square field containing 40 acres?

7. How many revolutions will a four-foot wheel make in 2 mi.?

8. A horse tied to a stake by a 60 ft. rope can graze over how much ground?

427. 1. Find the surface of a 3-foot sphere.

2. A tree broke off 16 ft. from the ground, and the top rested on the ground 20 ft. from the stump; how tall was it?

3. What is the diameter of a tree that girts 12 ft. 6 in.?

4. Find the diagonal of a square whose sides are 24 ft.

5. The diagonal of a square is 28 ft.; find one side.

6. When $4\frac{3}{4}$ tons of coal cost \$$35\frac{5}{8}$, what cost $7\frac{1}{2}$ tons?

7. \$$216\frac{1}{4}$ are the int. of $1580 for 2 yr. 9 mo. at what rate?

8. What sum gains $82.65 in 2 yr. 1 mo. 22 da. at 7%?

9. A house is 22 ft. wide; find the length of the rafters, if the gable is 6 ft. high?

10. Change 17 lb. Troy to avoirdupois wt.

11. Change 176 geographic miles to statute miles.

428. 1. How many sq. rd. in a rectangle 175 ft. by 95 ft.?

2. What is the length of one side of a square field which contains 12 acres?

3. In what time will $180 amount to $201.60 at 8%?

4. Sold 36 head of cattle at $16\frac{2}{3}$% profit, gaining $324; find the selling price per head?

5. An 8% note for $700, dated July 1, due in 30 days, was indorsed Aug. 30, $47; Nov. 25, 10; Dec. 20, $180; what was due at settlement on Jan'y 3, interest after maturity at 8%?

6. What is the area of a circle 56 in. in diameter?

7. $\sqrt{17.28}$ $\sqrt{5647}$ 8. $\sqrt[3]{1.728}$ $\sqrt[3]{18365}$

9. $3.8 \div .304 = ?$ 10. 3 oz. 7 pwt. × 24 = ?

429. 1. How long a cube contains 389017 cu. in.?

2. How long a square contains 59049 sq. ft.?

3. Find the surface of a cube whose edges are 30 in.

4. Find the area of a 20 ft. circle. (Art. 306.)

5. Find the diameter of a circle containing 3183.2 sq. ft.

NOTE.—The process in this ex. is the converse of that in the preceding.

6. What is the area of a triangle whose base is 16 rd., and altitude 24 rd.? (Art. 303.)

7. What is the altitude of triangle whose area is 10 acres, and base 64 rd.?

8. What sum invested at 6% will give $1.50 a day?

9. 2.4 are what % of $5\frac{1}{2}$. 10. Change 17 bu. to gal.

430. 1. What sum plus $\frac{1}{2}$ as much and $4 is $100 more than $\frac{4}{5}$ of it?

2. The net proceeds of a collection are $414.25; find the agents' commission at $2\frac{1}{2}$%?

3. In what time will $180 amount to $204.60 at 8%?

4. Find the square root of 1563; the cube root.

5. A paid $146.30 for a bill of goods at 30% and 10% off; find the list price?

6. What cost 4956 lb. of hay at $15.75 per ton?

7. Find the exact int. of $3560 from Mar. 7 to July 3, at 8%.

8. How is the commission found from the rate and proceeds?

9. What amount of surface has a cubic rod?

431. 1. How many feet of 2-inch plank will be required to build a box 6 ft. long 4 ft. wide and 2 ft. deep?

2. How many yards of plastering in the walls and ceiling of a room 18 ft. by $15\frac{1}{2}$ ft., 11 ft. high?

3. How many bricks cost $179.60 at $8.50 per M.?

4. The area of a room 21 ft. long is 56 sq. yd.; how wide is it?

5. How large a square can be drawn in a 20-in. circle?

6. 44 rd. $2\frac{1}{2}$ ft. are what decimal part of a mile?

7. What are 'days of grace'? Accurate interest?

8. Find the cube root of 15; the square root of 5314.41.

9. Define sphere; diameter of a sphere; radius.

10. 10% of the selling price is gain; what % is gained?

432. 1. A note for $800, payable in 30, was discounted at a bank, at 12%; what were the proceeds?

2. A note for $280, payable in 2 years, at 8%, dated Mar. 7, 1885, was indorsed Jan. 7, 1886, $23.50; Dec. 19, 1886, $117. What was due at maturity?

3. What cost a sight draft on Boston for $950, at $\frac{3}{4}$% premium? at $1\frac{1}{4}$% discount?

4. $77 were paid for a pile of wood 44 ft. long, 8 ft. wide and 4 ft. high; find the price per cord.

5. 12 mi. 63 rd. ÷ 2 ft. 6 in. = ? 6. 3 oz. 7 pwt. × 36 = ?

7. Reduce .3532 mi. to ft. 8. Change $516 to French Money.

9. How many feet high is a horse 16 hands high?

10. $\frac{3}{7}$ of a number 25% of it plus 10; find the number.

433. 1. What is the distance across a circular park which has an area of 6 acres?

2. A 30-foot ladder resting on the ground 15 ft. from the base of a wall, reaches it at what height?

3. What are the dimensions of a cubical cistern holding 10 barrels when half full?

4. The area of a circle is 5026.56 sq. in.; find the radius.

5. A's money is 9% less than B's; B's is what % of A's?

6. Find the amt. of $178.50 at 9% from Apr. 19 to Aug. 7.

7. Find the square root of $5\frac{7}{8}$. 8. Cube root of $9\frac{5}{16}$.

434. 1. A, B and C trade in partnership and gain \$5600; A's capital is \$8000, B's \$6000 and C's \$7000; what is each partner's share of the profit?

2. In what time will any sum double itself at 8%?

3. How much will it cost to carpet a room 20 ft. by 17 ft. with carpet $\frac{3}{4}$ yd. wide, at \$.87$\frac{1}{2}$ a yard, the breadths to run across the room, and be 6 in. longer than the width to match the figures?

4. If $\frac{2}{3}$ of 12 were 5, $\frac{3}{5}$ of 16 would be how much?

5. Find the length of the longest straight line that may be drawn on the floor of a room 18 ft. by 21 ft.

6. Find the volume of an 18-inch globe.

7. Find the surface of a cube whose edges are 30 in.

8. 350.1÷.0778=? 9. 3.7 are what % of 9$\frac{1}{2}$?

435. 1. 38 men begin a work which they could finish in 12 days; after 4 days, 6 men stop; how long should it take the others to complete the work?

2. A cistern 14 ft. square at the top and bottom contains 4900 gallons; how deep is it?

3. What cost 4320 pencils, at \$3$\frac{3}{4}$ per gross?

4. What cost a roof 51 ft. by 22 ft., at \$8.50 per square?

5. 180 planks 12 in. wide and 2 in. thick, were used in a bridge; they measured 5040 ft.; how long were they?

6. A 12-acre field is 60 rd. long; how wide is it?

7. What cost 87.5 lb. of lead, at \$5.60 per 100 lb.?

8. Sold a team for \$252, gaining 14%; find the gain.

436. 1. A lot of land containing 2 square miles, is what % of another 2 miles square?

2. If $\frac{3}{4}$ in. of rain fall, how many gallons will a cistern receive from a roof 32 ft. by 45 ft.?

3. How many board feet in a piece of timber 22 ft. long, 16 in. wide, and 12 in. thick?

4. How many bricks 8 in. by 4 in. will pave a walk 6 ft. wide around two sides of a lot 10 rods square?

5. If 10% is deducted from the asking price, which is 25% above cost, what is the rate of gain?

6. The surface of a cube is 1350 sq. in.; find the volume.

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